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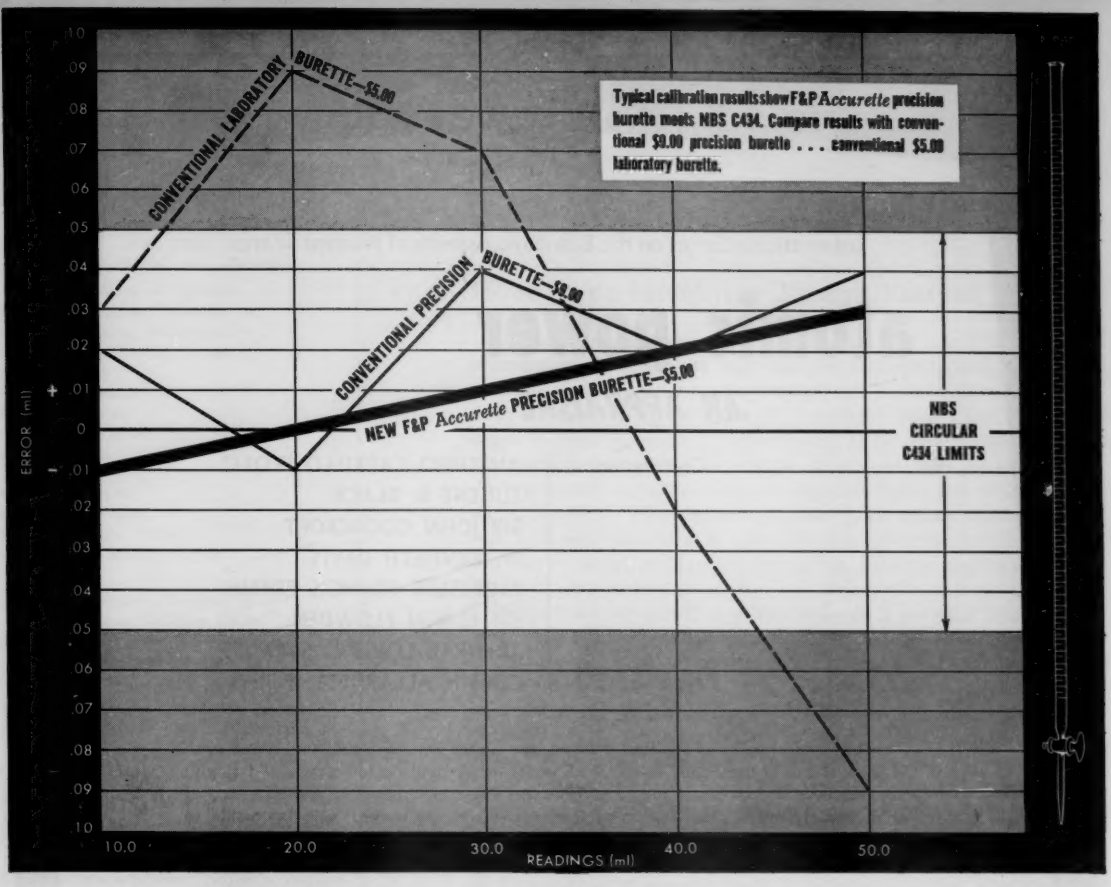

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	25	0.1	6	5.00	27.00
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How To Be Interesting Though Factual

In preparing a report of a new scientific finding, it is sometimes possible to entice a reader into sticking with you through apparently pointless stretches by intimating at regular intervals that you have discovered something in his private bailiwick that he had better know about. This technique, if crude, is legitimate. Indeed, some of the greatest literary artists use analogous techniques, for example, Dostoevski, who invariably opens the preliminary remarks necessary to introduce a new turn of events with the exclamation: "Then something happened that nobody could have foreseen, something that was to be talked about in our district for many years." But just as subtler methods are possible in fiction, so also in telling the story of a piece of scientific work.

Consider the sequence of steps that make up a successful inquiry. If an author merely describes those steps, then, even though the reader finds each move permissible and each result valid, the inquiry itself will appear to be just one thing after another. But, if, in addition, the author presents each step in terms of the purpose it serves, then the reader will see the inquiry as leading to the solution of a problem. Steps without direction are dull; solving a problem is interesting. Consequently, the way to get people who begin reading a paper to finish it is to develop a sense of purpose. In fact, once a paper is properly oriented, it will gain not only reader interest, but also such other essentials as coherence, clarity, and balance of detail. Teleological explanation may have no place in science proper, but to the extent that scientific investigations have to do with the intentions of men, it has a place in science writing.

To illustrate the advantages of explanation in terms of purpose, let us consider two possible ways of reporting the results of an imaginary inquiry. Our little inquiry offers a solution to a problem that occasionally arises in the course of preparing picnics, cold lunches, and similar repasts.

First version: Ordinarily, determining whether an egg is cooked or raw, without breaking the shell, poses no special problem. But suppose that several hard-boiled eggs—now cooled—are inadvertently mixed with several raw eggs. How then would you tell them apart? The following method requires no special equipment, only the application of a well-known physical principle. Place each egg on its side and attempt to spin it. If it spins easily, it is cooked; if not, it is raw. Raw eggs do not spin readily because the rotational energy is dissipated in the egg's interior, as dictated by the hydrodynamics of viscous fluids. To confirm the method, break the eggs.

Second version: Twelve white eggs were purchased at a supermarket. The eggs were divided into two groups of equal number. The eggs in the first group were boiled seven minutes and allowed to cool; the eggs in the second group were kept as controls. The eggs were mixed. Each egg was placed on its side, and an attempt was made to spin it, after which the egg was broken. It was easy to spin those eggs that subsequently were found to be cooked, but difficult to spin those eggs that proved to be raw. Etc., etc.

The strategy of developing a sense of purpose applies at any level: technical reports for fellow specialists, popular articles for scientists in other fields, and popular articles for the totally uninitiated. Authors know where they are heading; may they share that secret with the readers.—J.T.

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Man against His Environment: the Next Hundred Years

J. Murray Luck

There is a general consensus of opinion that the world population, possibly a million or so in 10,000 or 12,000 B.C., was about 300 million at the dawn of the Christian era. In the next 1650 years it doubled, and from its new base of 600 million it quadrupled to about 2400 million in the ensuing 300 years. Because of the acceleration in population growth revealed by the data of the past few hundred years, it is now evident that a mere 100 or 125 years will be required for the next quadrupling of the population. The forces that are in operation are so titanic and inexorable that one can entertain but the faintest hope of checking the growth rate of the human population within a century. Perhaps it need not be checked; this is the problem we shall explore. But be that as it may, to judge from the trends of the past 25 years, a world population of 9000 million and a United States population of 600 million by the year 2050 are almost inevitable.

These estimates are appreciably greater than those of Putnam (*1*) and Harrison Brown (*2*): six to eight billion for the world population and 375 million (*1*) for the United States. The former is projected from the estimates of world population made by Willcox (*3*) and by Carr-Saunders (*4*). In both cases, assumptions are introduced that are incompatible with trends of the past 20 years. Harrison Brown assumes that "(i) the population of Europe (excluding Eastern Europe) and North America will cease to increase appreciably after another quarter-century. (ii) The rates of population increase of Japan, Eastern Europe, and Oceania will decrease during the next 25 years to present Western levels. In an additional 25 years, the population will become stabilized. . . ." It is also conceded that these assumptions "are little better than guesses." Putnam's estimate of 375 million for the population of the United States in 2050 results from "an arbitrarily assumed decline in the growth rate from 17 [persons per thousand of population per year] in 1953 to 9 in A.D. 2000, and nil in A.D. 2050."

While these assumptions may appear to be plausible, it is not acceptable to ignore the fact that death rates throughout the world are much more likely to go down than to go up and should indeed tend to stabilize around the present rate of nine per 1000 (for the white population of the United States) or even fall somewhat lower. The net rate of population increase in the United States, influenced slightly by immigration and emigration, fell from around 3 percent per year in the first 70 years of the Republic to 1.0 or 1.2 percent in the late 1920's and to a minimum of 0.59 percent in 1932–33. Since then it has increased steadily to a 1950–51 rate of 1.76 percent. Our present rate of population increase is greater than that of India and even higher than the world average (*5*). This phenomenon in the United States has been paralleled in recent years by the gross birth rates of 14 countries, which fell to a minimum of 1.7 percent in the period 1933–37 and have been rising steadily ever since (2.3 percent in 1947).

As an assumption, fully as plausible as those advanced by Harrison Brown and Putnam—especially if we are concerned with the magnitude of the hazards against which man must prepare himself—a world rate of population increase of 1.33 percent per year through the next century is proposed. The same rate of population increase for the United States is postulated. This would give, for the United States in 1975, a population of 217 million, which agrees with projections made by the Bureau of the Census and with estimates reported by Wooten and Anderson (*6*).

Population Growth

The growth of our species closely parallels that of a culture of microorganisms, with a long latent period followed by a rapidly ascending growth phase. In 100,000 years or more our species increased its numbers to only 600 million, but in the last 300 years our numbers burst upward to 2400 million. If the analogy with a bacterial population were to be carried further, we might expect that the present rapidly mounting growth phase would eventually slow down and that there would emerge another period of latency, in which, with a high population density, an equilibrium would be struck between births and deaths; the period of rapid population growth would have ended. The facts that are now available to the demographer are quite insufficient for estimating this hypothetical equilibrium level of population. It would be absurd to attempt any such calculation (*7*). But, on the contrary, it is essential that we look forward 100 years, largely to budget for the future, and venture an estimate about whether the environment can be so changed or the requirements of our species so modified as to permit the earth to sustain a population burden of 9000 million.

Let us first be sure of our base lines—of the things that are relatively immutable.

Climate. The earth's climate has been fairly constant for the last 1000 million years, and there is no reason to expect any appreciable change during the next million years (*8*), let alone a hundred years. This is of considerable importance in the raising of food, since temperature, rainfall, and the amount of solar energy incident upon the earth are among the principal determinants (*9*).

Land areas. The earth is of finite size,

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and the land areas will remain relatively constant for many millennia.

Biosphere. Man and all the living things on which he depends live only in the very thin interface between the heavens and the earth. Man will not be able to give himself more elbow room by vast efforts at burrowing downwards or by fanciful migrations into space. For we are talking about a *lebensraum* problem affecting at least 40 million newcomers a year.

Food requirements. Although man has been tending toward a more sedentary form of life, there is no reason for believing that the food requirement of the individual adult can be reduced for prolonged periods below 2000 Calories per day.

Hereditary factors. Even if it were feasible to apply to man the skills in breeding that are applied to plants and domestic animals, there is little likelihood that even in thousands of years one could so alter the species as to enhance its chances of survival against the pressures that threaten to develop in the next few centuries.

Feeding 9000 Million People

Clearly, the most pertinent question is whether or not the world of 2050 will be able to raise enough food to support a population of 9000 million. The answer appears to be that it will be able to do so in a sort of way, although the present inequalities in distribution will be accentuated. The land area of the earth is about 36 billion acres, of which less than one-tenth, or 2 to 3 billion acres, is under cultivation. To this may be added 6 billion acres of pasture land, which, because of unfavorable climate, poor accessibility, or low fertility, would be marginal if partial conversion to agriculture were contemplated. Finally, we have another 1 to 1.5 billion acres of marginal land in the north and in the tropics which could be brought into cultivation only at tremendous expense and with great labor. Vast sums in capital investment would be required to maintain the stability of such soils, to prevent erosion, and to provide irrigation, or drainage, and fertilizers.

Nonetheless, it appears from the calculations made by Salter (*10*) that existing techniques would permit a doubling of world food production (from the 1946 level) as an attainable goal by the exploitation of 1.3 billion acres of this marginal land. In looking ahead still further, above all to the stated objective of feeding a quadrupled population, it seems probable that more of the pasture lands would have to be used—in some instances, at very great cost—to raise cereal grains and other plants for human consumption (*11*).

One of the basic rules in human nutrition is that, in an ideal diet, one-third to one-half of the protein intake shall be derived from animal sources. The peculiar merit of animal proteins, in general, is that they contain certain indispensable ingredients—half a dozen or so amino acids—which are usually not present in adequate amounts in seed proteins. All of these can now be synthesized in the laboratory and, indeed, the manufacture of amino acids is developing into a sizable industry. One need not be much of a prophet to predict with assurance that the day will come when the use of domestic animals for meat will be reduced and when the fortification of foodstuffs of vegetable origin with factory-made amino acids will correspondingly increase. Alternatively, we may learn how to extract the very nutritious proteins of leaves on a sufficiently vast scale to use these effectively as food supplements. The necessity of some such change in nutritional practice becomes evident when we realize that the world population of cattle, sheep, poultry, and swine consumes about three times the food calories consumed by man. Only a small part of this is food refuse, unfit for human consumption. Much of it is grain and plant material deliberately cultivated for the feeding of domestic animals, and much of it is derived from pasture lands which will eventually have to be brought into agriculture.

Over 60 percent of the world's population (most of Asia, Egypt, all of Central America, and some parts of South America) consumes, on the average, less than 2200 Calories per capita per day. And such an average is deceptive, for it conceals the fact that many people in the countries concerned receive less than 2200 Calories per day. But is it not true that food production has been increasing substantially the world over? Yes, even in Egypt. But population has increased even more rapidly. The director general of the United Nations Food and Agriculture Organization was forced to report, in 1951, that even though the world's production of food had increased by 9 percent since 1934–38, the population had increased by 12 percent. In consequence, available Calories were reduced from 2380 to 2260 per capita per day, and hunger and food shortages increased (*12*).

To feed 9000 million people in the year 2050, even at minimum levels, it is reasonably certain that vast sums will have to be expended in land reclamation, in the prevention of further erosion, in the manufacture of fertilizers, in the husbanding of nitrogenous and phosphorus-containing wastes, and in irrigation and water conservation. Fisheries will be extended into the southern waters; at present, 98 percent of the world's fish catch is from the Northern Hemisphere (*2*). Domestic animals, whether used for food or for work, will be displaced—the former by the synthetic products of the food industry, and the latter by the machine. The harvesting and cropping of food from the oceans and from the fresh waters of the earth will be carried out much more efficiently, and the cultivation of bacteria, yeasts, and photosynthetic algae for human food will be further developed where regional conditions are appropriate; sunlight and carbon dioxide are needed for cultivation of the latter, and rich carbohydrate wastes are needed for the former.

Natural and Synthetic Fibers

Not all the plants raised by men are for food. Some are raised to provide him with the fibers needed for fuel, clothing, housing, paper, packaging, and so on. Trees are the principal source of plant fibers, with a present world wood consumption of about 1000 pounds per year per inhabitant (*2*). The original 15 billion acres of forest land have been reduced by man to 10 billion acres, of which 6.5 billion acres lend themselves to reforestation and sustained-yield management (*2*). Next to wood fiber in importance comes cotton, and then jute. The former accounts for nearly 60 percent of the world's fiber production, exclusive of wood. However, only about 5 percent of the world's good cropland is used to raise such fibers, while 30 to 40 percent of the world's pasture land is used to raise the sheep and goats which provide us with animal fibers.

Insofar as this country is concerned, it has been calculated (*13*) that the production of natural fibers, expressed as a percentage of total fiber production, will decrease sharply. By 1975 natural fibers will constitute little more than 50 percent of the total fiber production in this country; synthetic fibers will make up the balance. In 1930, only 4 percent of our total fibers were synthetic. The total consumption of forest products, for all purposes, in the United States in 1975 will be not more than 10 or 15 percent greater than that of 1952 (*13*). This is a safe, short-term forecast, but from other estimates it seems reasonably certain that our forest products and natural fibers will be adequate for our needs through the next century. This prediction is necessarily based on the assumption that reforestation practices will continue, that inroads upon our forest lands will be negligible, and that the synthetic fiber industry will expand into certain

other countries as industrialization proceeds. A suggestion of things to come is to be found in the announcement that papers for specialized purposes can now be made from nylon and related synthetic fibers (*14*), though, for the moment, at the prohibitive price of $1 to $2 per pound (*15*).

Energy Requirements

In adapting to his environment, man has been making steadily increasing demands upon the energy-yielding substances and processes about him. His present requirements (exclusive of energy derived from food) approximate the energy equivalent of 10 tons of coal per capita per year (in the United States). In the nonindustrialized countries, the requirement is obviously much less. Up until quite recent years, man derived much of his energy from the burning of wood, from falling water, and from wind. While in 1800 the world production of energy from coal was negligible, it rose rapidly and, about 1880, began to be supplemented by that from petroleum and from hydroelectric sources (*16*). At the present time the U.S. consumption of energy approximates 160,000 kilocalories per person per day—an amount which is about 15 times greater than that required for a primitive agrarian existence and about 9 times the world average (*2*).

Fossil Fuels

What does the future hold in store for us insofar as nonfood energy sources are concerned? Half of the coal that has been consumed by man throughout his entire history has been burned since 1920. The reserves are still tremendous and, when supplemented by those of other fossil fuels (liquid petroleum, natural gas, oil shale, and tar), may amount to as much as 8000 billion tons. This is admittedly an optimistic figure for it pays scant attention to the economics of the problem, to the feasibility of extracting fossil fuels from fields that may be almost exhausted. The pessimists insist that our fossil-fuel reserves that are really amenable to extraction may prove to be as low as 800 billion tons (*2*).

Between 1940 and 1950 consumption of energy in the United States increased by 50 percent, and by 1960 it will certainly be 25 percent above the 1950 level (*17*). By 1975 we will be using energy at the rate of over 2 billion tons of "coal equivalent" per year, which is about that of the entire world at the present time. If we take into account the industrialization programs of eastern Europe, Asia, Africa, and South and Central America and the inevitable population increases of the next century, it becomes pretty clear that fossil fuels as sources of energy will have almost disappeared by the end of the next century—if present trends continue. We shall have consumed, in a scant 250 years, the fossil fuels that Nature required 250 million years to make.

To what extent will our reserves of energy in the form of unexploited hydroelectric power help us out? If they could all be put to use and put to use soon, and if we could exploit them on a maximum flow basis—three very large *if*'s—the power so derived might equal a coal equivalent of 4 billion tons per year. This could have a significant effect within the first few decades but would satisfy only 3 to 15 percent of the world's energy requirements a century from now.

Energy from Atomic Fission

And so we come to the atom, and none too soon. In 1898, Sir William Crooks, in his presidential address before the British Association for the Advancement of Science, predicted that exhaustion of the world's reserves of nitrates, then rapidly in progress, would spell the end of agriculture and, ultimately, of the species. But only 5 years were to pass before the means was discovered of fixing atmospheric nitrogen and of putting the new fixation processes at the service of agriculture. And so it is with the energy of the atom. At a most crucial moment in the history of man, scientific discovery has carried us into a new era, rich with tremendous possibilities for good and fraught with hazards of almost incredible magnitude. Just when the end of conventional sources of energy appears to be in sight, Nature reveals to man the vast new sources of energy hitherto locked within the atom.

Insofar as energy is concerned, there is no question but that the discoveries of the past few years have given us a new lease upon life. The exploitable reserves of uranium and thorium, the world over, have not been published in full. In our own country we have at least 180,000, and possibly 500,000, tons of uranium, expressed as U_3O_8, that may be mined at costs that should not prove to be prohibitive (*2, 18*). Even larger quantities of uranium are known to be in Canada, the Belgian Congo, and South Africa, while India and Brazil have rich deposits of thorium.

If it ever becomes feasible to extract the uranium from our low-grade shale and phosphate deposits and, perhaps ultimately, from our average granites, the new energy reserves would carry us very far into the future. Although the concentration of uranium and thorium in granite is very low, it is nonetheless such that, if these materials could be fully extracted, 1 ton of granite would yield an energy equivalent of 50 tons of coal. To consider the uranium and thorium of the United States alone, it may be calculated that 500,000 tons of these minerals, if fission could be carried to completion, would yield an amount of energy equivalent to that of 1500 billion tons of coal—an exploitable energy reserve which is fully equal to the world's fossil-fuel resources. World reserves of uranium and thorium have been estimated at 25 million and one million tons, respectively.

If the potential energy of these metals could be fully exploited by "breeder" techniques, this new reserve would equal 25 times that of the world's reserves of coal and 100 times the reserves of petroleum (*1*). The technical difficulties that have yet to be solved are, of course, enormous and involve the utilization of the plutonium-239 derived from uranium-238 and of the uranium-233 derived from thorium; the disposal or storage of radioactive wastes and residues; the maintenance of large inventories of uranium or thorium at every atomic power plant, and so on.

Despite all of this, progress is indeed rapid. It is now clear that Great Britain will be satisfying 20 to 25 percent of her total electricity requirements by atomic fission in 1965 and more than 40 percent by 1975 (*19, 20*). The nuclear reactor to be constructed in Somerset will have a net output of 500,000 kilowatts, which is more than 8 times that of the well-know reactor at Calder Hall (*20*). Belgium, France, Germany, Italy, Luxembourg, the Netherlands, and Japan have similar programs planned for the immediate future. In our own country there will be at least 1 million kilowatts of generating capacity in commercial atomic power plants by the end of 1960 (*21*). This will constitute only 0.7 percent of the electric power capacity that we shall then have available.

To look further into the future, it is possible that thermonuclear fusion processes will have developed sufficiently by 1975 or 2000 to give to the world atomic power plants that will be able to exploit the almost limitless reserves of deuterium with which we have been endowed. But this development awaits our ability to generate temperatures of 100 million degrees and to contain the ionized gases out of contact with the walls of the reactor—perhaps by magnetic means (*22*).

As a corollary to all of this it becomes evident that small reactors suitable for operation of motorcars and aeroplanes will have to be developed, impossible as

this seems at the moment, or our reserves of fossil fuel may have to be conserved to provide the liquid fuel that they will need. And here they will face the competition of the fast-growing petrochemical industry, to which we turn for rubber and plastics.

Solar Energy

Much has been written about the limitless resources of the sun as a source of energy. We are reminded by Ayres and Scarlott (*23*) that in only 3 days we receive from the sun as much energy as could be obtained by burning all our reserves of fossil fuels plus all of our remaining forests. It is admittedly humiliating to realize that man has not yet found a more satisfactory means of utilizing solar energy for nonfood purposes than to plant forests and burn the trees. Space-heating by solar energy is certainly in the offing, but the development of solar engines that will produce more than 50 horsepower per acre of collecting area seems to be remote. Doubtless the time will come when we shall have to devote many square miles of sunny collecting areas to solar engines, though, at the present stage of development, even 50,000 square miles so employed would, at fantastic costs, produce only 2 to 5 percent of our probable energy requirements 100 years hence.

Reserves of Metals

Several excellent studies have been made of our resources in metals, one of the most recent being that by the President's Materials Policy Commission, a five-volume report published in 1952 (*24*). An industrial society requires vast amounts of metals. As with uranium and thorium, any calculation of the world's reserves of the various metals is intimately related to economics. Just how far is man prepared to go and able to go in the processing of ores of low yield? Will our supplies of energy be sufficient, and will effective substitutes be found for several of the metals for which the reserves are negligible?

At the present level of technology, and on the assumption that industrialization will continue to increase in countries that are now largely agrarian, it is reasonably certain that the world's exploitable reserves of bauxite (the most important aluminum ore), copper, lead, zinc, tin, manganese, nickel, chromium, cobalt, cadmium, and so on will have diminished to the vanishing point within 100 years. Metallurgy will, of course, make tremendous progress. Lower-grade ores will be exploited. Aluminum will be recovered from clay, and magnesium, in vast quantities, from the sea. Indeed, it has been pointed out that, from 100 tons of ordinary igneous rock, 8 tons of aluminum, 5 tons of iron, 0.5 ton of titanium, 180 pounds of manganese, 70 pounds of chromium, and so on, might be extracted. But all of this would be done at the expense of incalculable amounts of energy. It seems increasingly probable that the survival of the species in a highly industrialized world will depend in part upon man's ingenuity to use sea water, air, ordinary rock, clay, and sunlight as direct sources of raw materials and energy. Some of our essential foodstuffs, especially a number of indispensable amino acids, will have to be produced in factories, since there is little likelihood that man can long continue to enjoy the luxury of domestic animals. It is also reasonably certain that our society will become so complex, because of the evolving pattern in industry, the pressures of high population densities, and the inevitable increases in controls of all sorts designed to husband our diminishing resources and to keep us at peace with our neighbors, that governments will become more and more pervasive, and more and more domineering; the precious freedoms of the individual will diminish.

"Population Bomb"

Will it be worth while for our children and our grandchildren to struggle against such terrific odds and against so grim a future? Indeed, the struggle is worth while, but it is more and more necessary that we become fully aware of the forces with which we must wrestle, and every reasonable proposal that allegedly offers hope of improving our plight must be examined on its merits. The crux of the problem is explosive population growth; we are caught in the fast-mounting growth phase of our species. Is it possible for man "to call the shots," to fix that optimum level at which the world's population should become constant, to determine the equilibrium at which birth rates and death rates are equal, and to maintain the balance so determined with the precision that would be required? As has been so well stated by Robert Cook (*25*), "the population bomb is as great a threat to mankind as the nuclear bomb. Fortunately its fuse is longer."

We must, of course, realize more clearly than we do the dire consequences of a modern war. War, it has been alleged, in any primitive agrarian or food-collecting economy served to kill off excess numbers, to reduce population pressures, and to redistribute more equitably the food supplies and essential resources. But in a highly industrialized society, into which much of the world is moving, war can no longer be waged without catastrophic consequences. The 100 million who might be lost in another world war (*26*) represent only 2.5 years' increment to the world's population, but the attendant disruption of industry would be so complete that recovery would be improbable. The peoples of our industrialized nations are now so dependent upon industry for food and the means of transporting food, for the chemicals required in the prevention and treatment of disease, for their clothing, and so on, that a serious decrease in industrial output would be attended by disease, a sharp increase in the death rate, and reversion of the survivors to a primitive agrarian economy.

Part of the answer to the population problem is to be found in the maintenance of a very delicate balance between industry and agriculture and by a worldwide reduction in the birth rate. Science is in the paradoxical position of having given to man the means of reducing death rates and the techniques necessary for lowering birth rates but of distributing these bounties to a world that is eager to receive the former and is hostile toward the latter.

In instance after instance, the conquest of disease has served only to aggravate the major problem. In Ceylon, DDT was introduced in 1946 in a heroic effort to eliminate the *Anopheles* mosquito, the carrier of malaria. The experiment succeeded; the death rate fell from 20 to 13 in 2 years, the birth rate remained high, food production remained at the old level, and hunger and starvation increased in severity. In British Guiana infant mortality was reduced in 2 years from 350 per 1000 of population to 67. The population of the colony is now doubling every 7 years (*1*). It would be easy to show that the rapid introduction of modern sanitation practices in Egypt, India, Mexico, and Pakistan, for example, with the possible elimination of typhoid fever, infectious dysentery, and enteritis, would reduce the death rate very appreciably and, for a time, would have disastrous results on the feeding of the people; starvation and famine could attain epidemic proportions. Increasing birth rates are as serious as decreasing death rates in aggravating the population problem. I shall not attempt to explore the factors that alter birth rates; it is sufficient to mention that the causes are admittedly complex. Higher birth rates appear to be associated in part with an improvement in economic status and with the encouragement given by government, in subsidies and tax relief, to the bearing of children.

Population Control

Many remedies for the population problem are proposed. No one person can lay claim to sufficient knowledge to de-

fine a pattern of social policy that would prove effective and acceptable in achieving population control in a world as complex as ours has become. But we would be seriously remiss if we did not remind ourselves of some of the remedies that hold forth an element of promise. Abortion, at the request of the prospective mother, should not only be permitted but, in some instances, encouraged. Education in the practice of contraception should be increased and, in some regions, clinics for the teaching of contraception should be encouraged. Research on this important subject should be fostered, especially in the hope that an effective contraceptive "pill" could be developed. Governments should give serious thought to the advisability of decreasing the subsidies, family allowances, and direct benefits extended to the parents of children and the indirect relief extended through tax reductions. Possibly parents should enjoy a tax exemption of $600 for every child they do *not* have instead of a $600 reduction in taxable income for every child they do have.

It is well to recognize that research aimed at the conquest of disease and at reduction of death rates will and must continue at a high level. The desire to alleviate suffering and to save life is an expression of one of the highest spiritual values in man. It should also come to be recognized that the elimination of hunger and starvation and the improvement of the nutritional status of the poor are equally desirable objectives. But there is no hope of attaining these goals without population control. I would like to believe that the tremendous forces of organized religion and of popular education will, in the days of our children and our grandchildren, overcome the superstition, the ignorance, the apathy, and the psychological hindrances that now stand in the way of population control. I would like to believe that governments, frustrated though they may be in attempts to solve the relatively minor problem of disarmament, will be able to work in concert on the even greater, but related, problem of sharing, for peaceful purposes, the material resources of the world and of developing an acceptable program of world population control.

Lewis Strauss, chairman of the Atomic Energy Commission, in discussing the question "Can man learn to live with his inventions, or must he perish because of them?" has called for an international conference to study the "serious threats to the welfare, even the life, of the human race" that are resulting from man's inventiveness in physics, chemistry, engineering, medicine, and biology (*27*). Alexander Haddow, in calling attention to the need for an international science council, has reminded us of Lord Lindsay's proposal in 1946 that a permanent international council of scientists be organized within the framework of the United Nations (*28*). I would like to believe that our own Government will make greater use of the resources of the National Academy of Sciences for advice on the scientific aspects of matters such as these. I believe—this is a quite personal opinion on government policy—that it will eventually be necessary for the countries that are advanced technologically, and that have the resources to permit them to aid other countries, to act in concert in extending such assistance. An essential prerequisite for such assistance should be clear proof that the applicant country has introduced an acceptable program of population control and will not continue to burden the rest of the world with all the troubles inherent in expanding populations. There is, in my own mind, some question, also, about whether we have any right in our own country, in the interest of attaining higher standards of living, to drain the rest of the world of many of its precious natural resources unless we initiate measures to reduce our own rate of population increase.

There are those who insist that we shall be "sitting pretty" as long as our agricultural and industrial productivity keeps ahead of our population growth. I would submit, however, as Stanley Cain puts it, that this battle between production and reproduction will never be won by production alone.

Never-Ending Struggle

Almost every previous crisis in the history of man, except those that confronted the civilizations of the Mediterranean basin, have been solved by man's inventiveness. The life-or-death problem that now confronts the species is, paradoxically enough, the culminating result of man's ingenuity in solving his material problems. The solution of today's problem demands infinite wisdom and human understanding as well as technical progress, for the adaptations we must make in the next century will not be in material things alone. We shall have to adapt emotionally and morally. Our world of ideas, our standards of right and wrong, our ethical judgments, the things of the spirit, will be subject to strange new pressures as our cities grow larger, as expanding populations draw more heavily upon us, as governmental controls reach farther and farther into even the sanctities of our lives, and as our personal freedoms diminish.

I have described the battle of man against his environment and have indicated that his days are numbered if present trends in population growth are continued. The qualification is important, for I have enough faith in the inherent wisdom of man to believe that present trends will not be allowed to continue and that we shall have a world in which the material and spiritual values of the good life can be enjoyed for many many centuries to come. In the vastnesses of these problems the physical scientists are optimists; they are keenly aware that the technological progress of the future may shade into oblivion the advances of the past. The biologists are traditionally pessimists. They know that species may come and species may go. Being a biochemist, I am necessarily an "optipessimist." As such, I can only express the faith that man, in the wisdom with which he has been endowed, will continue to triumph in the never-ending struggle to sustain the individual and the species.

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Yale Natural Radiocarbon Measurements III

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Earlier papers from our laboratory have reported measurements of natural radiocarbon made by Libby's solid-carbon method (*1, 2*) and by Suess' acetylene method (*3*). In this article, we give results obtained between July 1955 and March 1957 (*4*), mainly by the carbon dioxide method of de Vries and Barendsen (*5*), which we have had in operation since December 1955. Work with acetylene is never entirely free from danger of explosion, as we know from experience. Moreover, the yield of acetylene is less than 100 percent, so that larger samples are required and isotopic fractionation is possible. In extending the range and accuracy of radiocarbon dating by use of larger samples, we intend to take advantage of the fact that carbon dioxide can be compressed under many atmospheres without attendant risk.

Technique

A counting system including a high-pressure proportional counter and appropriately high voltages is being installed for full realization of the advantages of the carbon dioxide method. Meanwhile, we have conducted routine dating in the same counters that were previously used for acetylene. These counters were not designed for use at high pressures. Thus, when counter 1 is filled with carbon dioxide to a pressure of 137 millimeters of mercury, it shows a background of 8.8 disintegrations per minute, and counter 2 (which has no shielding inside the ring of anticoincidence counters) has a background of 10.1 disintegrations per minute; the net activity of the modern reference standard (hemlock wood laid down between A.D. 1840 and 1850) is close to 20.0 disintegrations per minute in each counter.

We have made no important changes in the system for purification of carbon dioxide that was developed by de Vries and Barendsen. Final purification, primarily for removal of radon, is accomplished by permitting the gas to react at 800°C with calcium oxide that has been prepared from ancient calcite to insure radiochemical purity. After gaseous products are pumped away at 400°C, the carbon dioxide is liberated by increasing the temperature of the carbonate to 900°C.

Corrections of several sorts have increased the stability of the background and modern counting rates, and thus the accuracy of the dates. Changes in room temperature are compensated for during filling of the counters; the purity of the filling gas is tested before and after a run by examination of the relation between over-all counting rate and voltage in the region where this relation is linear and steep; changes in barometric pressure (with which the meson component of the over-all counting rate is inversely correlated) are corrected for when necessary. Application of these various corrections may change the observed counting rate of a sample by as much as 2 percent; corrected counting rates for anthracite and for "modern" wood then prove to be extremely stable over periods of several months, with occasional fluctuations that are attributed to neutrons (associated with solar flares). We have also observed slow, systematic but unexplained changes in background counting rate, which do not affect the calculated dates because of the frequency with which calibration runs are made.

The routine practice in dating is to make duplicate 24-hour runs, one in each counter. Calibration runs are made over weekends. The net sample/net modern wood ratios for duplicate determinations normally agree within the statistical error, so that the two can be combined into a single date. Such dates are listed in Table 1; we make no distinction between dates obtained by the acetylene method and those obtained by the carbon dioxide method.

Results

Calcareous samples have been entirely avoided because of uncertainty about the modern carbon-14 assay with which they should be compared and because of the possibility of carbon exchange between lime and atmosphere or ground water. A few preliminary studies of the radiocarbon content of modern wood from Guatemala and Yucatan have confirmed the existence of the Suess effect (*6*) (decreased radioactivity since A.D. 1900, owing to admixture of "dead" carbon from combustion of coal and petroleum); they give no support to the suspicion that forest trees in the Maya area might incorporate an appreciable amount of old carbon from a limestone substratum. Further studies of the modern assay have been deferred until mass-spectrometric studies of carbon-13 can be conducted simultaneously.

Of the major projects represented by dates in Table 1, three are essentially complete. The Alaskan Little Ice Age is

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discussed in a paper by E. S. Deevey, D. B. Lawrence, and K. B. Bengtson (*7*). Caribbean archeology is discussed by Irving Rouse, J. M. Goggin, and J. M. Cruxent (*8*). A separate paper is not planned for the third project, on European Paleolithic to Neolithic, but a summary of the new dates, together with previously published dates of significance to the pollen chronology of northwestern Europe, is given for ready reference in Fig. 1; Table 2 is a check list of these dates. Studies are being continued on North American geology (with R. F. Flint), including the pollen-stratigraphic section for which E. S. Deevey is primarily responsible, and on the Southern Hemisphere (with various collaborators).

Table 1. Radiocarbon dates obtained by the acetylene and carbon dioxide methods. All ages are given in years before A.D. 1955. "Modern" means that the radiocarbon assay did not differ significantly from that of the reference standard.

Description	Sample No.	Age
I. *Alaskan Little Ice Age and related samples*		
Bengtson 46. Wood from 4-ft log imbedded in till, below the upper limit of till deposition at the end of a spur projecting into the east side of the south part of Brady Glacier, Glacier Bay district, at 1600-ft altitude at the location of sample Y-37 (*3*). Collected in 1950 and submitted by K. B. Bengtson. *Comment*: samples Y-37 and Y-32 were remains of alpine timber in similar stratigraphic positions; both were dated "modern." The large log reported here was transported to the locality by a glacier, but does not prove to be significantly older.	Y-36	Modern
Lawrence F55-1. Transported log, found on top of varved clay exposed in north wall of valley of Goose Cove Creek about 1/10 mi east of entrance of creek, east shore of Muir Inlet, Glacier Bay. Collected in 1955 and submitted by D. B. Lawrence.	Y-301	2265 ± 80
Lawrence F55-2. Stump, rooted in place, top torn by ice moving from north, exposed at north margin of valley of Goose Cove Creek about 1/10 mi east of entrance of creek, east shore of Muir Inlet, Glacier Bay. After its death, the tree was buried by 35 ft of varved clay, on top of which sample Y-301 was found. Collected in 1955 and submitted by D. B. Lawrence.	Y-302	4330 ± 80
Lawrence F55-3. Hemlock (?) stump, about 36 ft above high-tide level, rooted in place on varved clay 4 ft thick, overlain by 10 ft of sand and gravel, about 60 ft of varved clay, and 26 to 30 ft of sand and gravel, in the upper part of which sample Y-304 was found rooted in a buried soil horizon. The section is exposed at W. S. Cooper's station 20 (*9*, p. 119, Fig. 12, lower right), on the west shore of Muir Inlet, Glacier Bay. Collected in 1955 and submitted by D. B. Lawrence.	Y-303	3290 ± 55
Lawrence F55-4. Hemlock stump about 136 ft above high-tide level, rooted in a buried soil horizon overlying outwash, varved clay, and the fossil forest bed from which sample Y-303 was taken, at W. S. Cooper's station 20 (see Y-303). Collected in 1955 and submitted by D. B. Lawrence.	Y-304	1765 ± 50
Lawrence F55-5. Stump, rooted in soil on bedrock at 200-ft altitude and exposed by stream erosion at W. S. Cooper's station 20 (see Y-303). The forest zone is the uppermost zone exposed at this locality. Collected in 1955 and submitted by D. B. Lawrence.	Y-305	850 ± 100
Lawrence F55-6. Stump, rooted in soil on bedrock at 180-ft altitude and exposed by stream erosion (20 ft below sample Y-305) at W. S. Cooper's station 20 (see Y-303). Collected in 1955 and submitted by D. B. Lawrence.	Y-306	1710 ± 60
Lawrence F55-7. Stump, rooted in place about 10 ft below high-tide level, eroded from outwash by wave action, west of the north end of Willoughby Island, on the west shore of Glacier Bay. Collected in 1955 and submitted by D. B. Lawrence. *Comment*: this sample essentially duplicates sample Y-8 (4050 ± 150 yr) (*3*), which was collected by Bengtson at a nearby locality.	Y-307	3745 ± 100
Lawrence F55-8. Hemlock stump, rooted in place in intertidal zone on southern point of Lester Island at the north entrance of Bartlett Cove, Glacier Bay. Collected in 1955 and submitted by D. B. Lawrence. *Comment*: this sample essentially duplicates samples Y-132-83 and Y-132-86 (*3*), both of which were dated "modern."	Y-308	Modern
Helm Glacier, British Columbia. Wood from forest tree killed by advance of Helm Glacier to its recent maximum and exposed by its retreat since A.D. 1940, east tongue of Helm Glacier (*10*, locality 1, p. 366), Mount Garibaldi map area, southwestern British Columbia. Collected in 1955 and submitted by W. H. Mathews.	Y-346	Modern
Sphinx Glacier, British Columbia. Wood from forest tree killed by advance of Sphinx Glacier to its recent maximum and exposed by its retreat since A.D. 1940, north edge of Sphinx moraine (*10*, locality 4, p. 366), Mount Garibaldi map area, southwestern British Columbia. Collected in 1955 and submitted by W. H. Mathews.	Y-347	460 ± 40
II. *European Paleolithic to Neolithic*		
A. *British Isles*		
Clonsast recurrence horizon. Pine stump from about 75-cm depth in Clonsast bog, county Offaly, Eire. The pollen zone is that of the second elm maximum, associated with a recurrence horizon that is correlated with RY II, A.D. 400, in Sweden. Collected and submitted by G. F. Mitchell. *Comment*: a portion of the same stump (sample GRO-271) was dated 1485 ± 150 yr by the Groningen Laboratory (*11*, p. 202).	Y-94	1610 ± 80
Clonsast, early sub-Boreal. Pine root from 220-cm depth, overlying temporarily dried fen peat, overlain by highly humified *Sphagnum* peat, Clonsast bog, county Offaly, Eire. The decline of elm pollen (beginning of agriculture) lies at a depth of 250 cm, and a maximum of oak pollen that is contemporary with early Bronze Age objects lies at 180-cm depth in the same bog (*11*, p. 203).	Y-93	4170 ± 80

Description	Sample No.	Age
Collected in 1951 and submitted by G. F. Mitchell. *Comment*: sample C-358, peat from a level in Clonsast bog corresponding to a depth of about 275 cm in the same pollen diagram (*11*, p. 204), was dated 5824 ± 300 yr by Arnold and Libby (*12*). The horizon has been placed as early Atlantic by Mitchell (*13*).		
Toome Bay Mesolithic. Charcoal from hearth in Section D/6, 1951, Toome Bay, county Londonderry, Northern Ireland. Late Mesolithic culture underlying peat of pollen zone VIb, late Boreal (*14*). Submitted in 1951 by G. F. Mitchell.	Y-95	7680 ± 110
Upton Warren. Organic sediment from near the base of a 30-ft sand-and-gravel fill constituting a terrace of the river Salwarpe near Droitwich, Worcestershire, England. The fill is correlated with the Main Terrace of the river Severn, in turn a correlative of the Irish Sea ("Newer Drift") glacier. The deposit contains a "cold" mammal fauna. Collected in 1955 and submitted by F. W. Shotton, whose designation was band 2. *Comment*: the sample was measured five times in two counters, each time with results slightly but not significantly above background, but collectively suggesting an age only slightly in excess of 40,000 yr. It was therefore submitted to the Groningen laboratory, where it gave the measurement of 42,300 ± 1300 yr (sample GRO-595) (*15*).	Y-311A	> 38,350
Penkridge. Peat from the lowermost 5 cm of a peat deposit 250 cm thick, overlying sand, Penkridge, near Wolverhampton, England. The deposit fills a kettle in drift of the Irish Sea ("Newer Drift") glacier, at least 20 mi south of the outermost position reached by younger glaciers. Postglacial pollen zones (zone IV to VII) begin at a height 105 cm above the base of the deposit; the late-glacial pollen sequence is receiving further study. Collected and submitted by F. W. Shotton.	Y-464	10,670 ± 130
B. *Netherlands*		
Usselo Alleröd. Sandy peat from a depth of 160 to 165 cm, at base of Alleröd zone, profile IV Usselo A, Overijssel Province. The section was described with complete pollen analysis by van der Hammen (*16*). Submitted in 1951 by R. D. Crommelin.	Y-139-1	12,500 ± 180
Usselo culture. Sandy peat from a depth of 127 to 132 cm, at base of culture-influenced part of Alleröd zone, in the same locality and profile as sample Y-139-1. Submitted in 1951 by R. D. Crommelin.	Y-139-2	10,880 ± 160
Usselo, Upper Dryas. Sandy peat from a depth of 107 to 113 cm at base of Upper Dryas zone, in the same locality and profile as sample Y-139-1. Submitted in 1951 by R. D. Crommelin. *Comment*: the age of this sample is obviously too great, but the reason is not known.	Y-139-3	11,350 ± 150
Vriezenveen, below recurrence horizon. Eriophorum peat immediately below recurrence horizon (*Grenzhorizont* of C. A. Weber), Vriezenveen, Overijssel Province. Submitted in 1951 by R. D. Crommelin.	Y-139-5	3525 ± 200
Vriezenveen, above recurrence horizon. Base of *Sphagnum cuspidatum* peat immediately above the recurrence horizon in the same locality and profile as sample Y-139-5. Submitted in 1951 by R. D. Crommelin. *Comment*: the wide difference in age between the two samples reflects the fact that samples collected in 1951 for measurement by the solid-carbon method were undesirably large; with the closer spacing now possible, the Groningen laboratory (*17*) reports much closer agreement between samples collected from above and below recurrence horizons. If the Vriezenveen recurrence horizon is not that of Weber, RY III in the Swedish series, 600 B.C., it is an older one—for example, RY IV, 1200 B.C. Measurements made at the University of Chicago on a similar pair of samples from Melbeck in northern Germany (samples C-449, 1129 ± 115 yr and C-450, 1449 ± 200 yr) (*12*) are confirmed by the Heidelberg Laboratory (H-163-156, 1240 ± 60 yr; H-164-160, 1500 ± 80 yr) (*18*) but are now believed on stratigraphic as well as radiocarbon evidence to date RY II, A.D. 400; see sample Y-94 for an Irish correlative of RY II. The problem is being studied in the Heidelberg laboratory (*18*); of nine horizons so far measured in seven bogs, two prove to date RY II, three to date RY III, and four date a distinct horizon of intermediate age, about 100 B.C.	Y-139-6	2720 ± 90
Oud-Loosdrecht, above recurrence horizon. Young *Sphagnum* peat immediately above recurrence horizon, Oud-Loosdrecht, Utrecht Province. Submitted in 1951 by R. D. Crommelin.	Y-139-10	2190 ± 90
Oud-Loosdrecht, below recurrence horizon. Older *Sphagnum* peat (with *Eriophorum*), immediately below recurrence horizon in the same locality and profile as sample Y-139-10. Submitted in 1951 by R. D. Crommelin. *Comment*: this pair of samples agrees with that from Vriezenveen in proving that the recurrence horizon is not RY II; it does not distinguish between RY III and RY IV.	Y-139-11	3630 ± 90
C. *Germany*		
Rissen. Fragments of charcoal from various parts of the late Magdalenian culture layer, Rissen, near Hamburg. Collected in 1948 by H. Schwabedissen and submitted by Hallam Movius. *Comment*: sample Y-157A, being charcoal and all of one age, is believed to provide the best available date for this important horizon.	Y-157B	9280 ± 290
Rissen Magdalenian. Charcoal from hearth, late Magdalenian culture, Rissen, near Hamburg. Pollen age, Alleröd, at transition to Younger Dryas. Collected in 1948 by H. Schwabedissen and submitted by Hallam Movius. *Comment*: the Rissen culture is identical with that of Usselo (see sample Y-139-2), and the age of both agrees	Y-157A	10,560 ± 200

Description	Sample No.	Age
closely with the most accurate dating of late Alleröd time (samples K-101, K-102, K-103, mean 10,830 ± 200 yr; sample K-110, 10,770 ± 300 yr) (*19*). The dates obtained by the Washington laboratory are slightly younger, though not by a significant margin (samples W-82 and W-84, mean 10,400 ± 160 yr) (*20*). The Heidelberg date for charcoal of the Rissen culture (H-75-68, 11,450 ± 180 yr) (*18*) must therefore be regarded as too old, although the dates for the underlying wood and gyttja are consistent with that for charcoal.		
Meiendorf Hamburgian. Antler from late Upper Paleolithic (Hamburgian) culture layer, Meiendorf, near Hamburg. Pollen age, Oldest Dryas (zone I). Submitted by H. Schwabedissen through Hallam Movius. *Comment*: because the antler appeared fresh and moderately organic, it was burned after acid-washing, giving an obviously false date (sample Y-158). Separation into acid-soluble or carbonate (sample Y-158-1 and acid-insoluble or organic (sample Y-158-2) fractions showed that the carbonate fraction is young and that carbonate infiltrated the specimen after deposition. A similar experiment with Meiendorf antler by Rubin and Suess (*21*) showed no difference in age between acid-insoluble (sample W-264, 11,790 ± 200 yr) and the merely acid-rinsed fraction (sample W-281, 11,870 ± 200 yr). However, a more elaborate study by Münnich (*18*) at the Heidelberg laboratory confirms the fact that the infiltrated carbonate of antler, including specimens from Meiendorf (H-38-121), is younger by several thousand years. Organic-carbon fractions of this antler (H-38-121A, H-38-121B) gave ages of 12,000 ± 300 yr and 12,300 ± 300 yr, but these are still too young for Oldest Dryas. The slightly younger culture from Poggenwisch in the same region gave dates about a thousand years older (H-31-67, organic fraction of antler, 13,050 ± 270 yr; H-136-116, wood, 12,980 ± 370 yr). On the other hand, gyttja samples from Meiendorf (sample W-172, 15,750 ± 800 yr) (*22*) and Poggenwisch (sample W-93, 15,150 ± 350 yr) (*20*) seem to be too old, presumably because of the "hard-water lake" effect (*2*). The Heidelberg laboratory (*18*) obtained a similar result for the organic fraction of gyttja from Poggenwisch (sample H-32-60, 15,700 ± 350 yr), but found the calcareous fraction to contain an older component (sample H-32-118a, 17,100 ± 560 yr) that was removable by dialysis (sample H-32-118c, 12,850 ± 500 yr).		
Antler, burned after acid washing.	Y-158	9540 ± 130
Acid-soluble fraction of antler.	Y-158-1	7060 ± 400
Acid-insoluble fraction of antler.	Y-158-2	10,760 ± 250
Stellmoor Ahrensburg. Reindeer antler from the Ahrensburg (early Mesolithic) culture layer at Stellmoor, near Hamburg. Pollen age, Younger Dryas (zone III). Submitted by H. Schwabedissen through Hallam Movius. *Comment*: procedures identical to those used for sample Y-158 confirm the infiltration by younger carbon as carbonate. The date of the organic fraction seems entirely reasonable for a zone III culture, but as long as it rests on antler it must be treated with reserve.		
Antler, burned after acid washing.	Y-159	9310 ± 260
Acid-soluble fraction of antler.	Y-159-1	5340 ± 200
Acid-insoluble fraction of antler.	Y-159-2	10,320 ± 250
Lieth Alleröd. Peat from dune sand of late glacial age, Lieth, near Elmshorn, Kreis Pinneberg, Schleswig-Holstein. Pollen age, Alleröd (zone II of Firbas) (*23*). Collected by E. Kolombe; submitted in 1955 by H. Schwabedissen.	Y-442	11,220 ± 350
Duvensee Mesolithic. Decomposed hazel nuts (Nussmüll) from Mesolithic culture layer (upper Duvensee stage) at Duvensee, Schleswig-Holstein. Pollen age, early Boreal, zone VIa of Overbeck (*24*) (equivalent to zone V of Firbas, *23*; for correlation, see Schmitz, *25*). Submitted in 1951 by H. Schwabedissen. *Comment*: Heidelberg dates for this culture layer are in agreement: sample H-23-22, birch wood, 9200 ± 300 yr; H-26-23, hazel nuts, 9030 ± 350 yr (*18*). The culture is slightly younger stratigraphically than the Mesolithic culture of Star Carr in Yorkshire (sample C-353, 9488 ± 350 yr) (*12*).	Y-161	8760 ± 70
Rüde Mesolithic. Wood from culture layer, about 50 cm thick, of Ertebölle/Ellerbek (Mesolithic or proto-Neolithic) culture in Satrup Moor, Rüde, near Schleswig, Schleswig-Holstein. Pollen age, Atlantic, zone VIIIb of Overbeck (*24*) (equivalent to zone VII of Firbas, *23*). Submitted by H. Schwabedissen.		
Carbonized wood from upper part of culture layer, 1955 excavation, Fläche F, quadrat 78 a/b, Sch. 96c, between bark floors of a house.	Y-471	5620 ± 50
Carbonized wood from lower part of culture layer, 1955 excavation, quadrat 121-c, Kies, Sch. 82.	Y-441a	5620 ± 200
Wood from 1951 excavation.	Y-160	5690 ± 70
Ellerbek Mesolithic. Worked wood from the Ertebölle/Ellerbek culture at Ellerbek, near Kiel, Schleswig-Holstein. Submitted by H. Schwabedissen; his designation: Sch. 56h.	Y-440	6060 ± 200
Südensee-Damm Neolithic. Log, sharpened by stone ax, from base of layer, about 20 cm thick, of early Neolithic culture in Satrup Moor, Südensee-Damm near Schleswig, Schleswig-Holstein. Pollen age, early sub-Boreal, zone IX of Overbeck (*24*) (equivalent to zone VII-VIII of Firbas, *23*). The log lay in horizontal position at 156-cm depth, Fläche C, quadrat 34b, Sch. 94c, under a funnel-beaker, at the top of a layer of fine-detritus gyttja; remains of the Ertebölle/Ellerbek (Mesolithic) culture lay in peat, pollen-dated to zone VIIIb of Overbeck, between 165- and 185-cm depth in the same section. Submitted by H. Schwabedissen.	Y-472	4960 ± 50
Heidmoor Neolithic. Wood and charcoal from the Neolithic site of Heidmoor, Gem. Berlin, Kreis Segeberg,		

Description	Sample No.	Age
Schleswig-Holstein. Pollen age, late Atlantic or early sub-Boreal. A sample of wood (Y-162), submitted in 1951, gave an obviously erroneous date for the Neolithic culture; it may have come from the older Ertebölle/Ellerbek culture, which is present on the site (see samples Y-160, Y-441-a, Y-471, Y-440). New excavations in 1955 permitted subdivision into upper and lower culture levels within the Neolithic deposit. Submitted by H. Schwabedissen.		
Charcoal from lower level, Field A1, Sch. 75.	Y-443b	4530 ± 170
Charcoal from lower level, Field E, Sch. 81.	Y-443h	4210 ± 80
Charcoal from upper level, Field D, Sch. 78.	Y-443e	4400 ± 170
Wood, submitted in 1951.	Y-162	5940 ± 100
D. *Denmark*		
Herning. Gyttja from the upper (post-Middle-Bed) gyttja layer at Herning, Jutland. (Jessen and Milthers, *6*, layer F). Content of older pollen (for example, from the underlying interglacial gyttja) slight or negative, according to studies by S. T. Andersen. Collected in 1954 and submitted by S. T. Andersen; his sample number: 2812. *Comment*: this sample was evidently contaminated by younger carbon, as shown by the next two dates.	Y-257	19,580 ± 730
Herning. Gyttja, in the form of dark lumps in lighter-colored material, from the upper gyttja layer at Herning (layer F, see sample Y-257). Pollen studies of the lumps and the matrix show no differences, providing no support for the view that the gyttja as a whole was redeposited from older (interglacial) deposits. The gyttja, however, contains a certain proportion of redeposited interglacial pollen. Collected in 1954 and submitted by S. T. Andersen; his sample number: 2737.	Y-258-3	> 30,000
Rodebaek. Gyttja from the upper gyttja horizon at Rodebaek, Jutland. According to pollen studies by S. T. Andersen (*27*) the deposit is somewhat older than the gyttja horizon at Herning (see sample Y-257), but there is some possibility of admixture of older material. Collected in 1954 and submitted by S. T. Andersen; his sample number: 2542. *Comment*: in view of the possibility that the underlying Middle Bed corresponds to the Würm I glaciation, the gyttja may yet give a finite date, and new samples are being obtained for the purpose.	Y-259-1	> 40,000
E. *Finland*		
Varrassuo bog. Peat from near point 2 (*28*, Fig. 9) in Varrassuo bog, near Lahti, formed in a lake dammed by the Salpausselkä moraine system, thus immediately postdating the maximum glacial advance of the Fennoscandian subage. The pollen diagram has been published by Donner (*28*, Fig. 13). Collected and submitted in 1956 by Joakim Donner. *Comment*: the dates are about 3000 yr too young, presumably because the peat has undergone postdepositional exchange with younger carbon. Alkali washing of the material left no woody residue that could be used for a new measurement.		
Equisetum brown moss peat from depth of 389 to 399 cm (top of zone III, Younger Dryas), overlying silt and sand; Donner's sample A.	Y-482	8030 ± 140
Sphagnum-Carex peat from depth of 375 to 385 cm (zone IV, pre-Boreal); Donner's sample B.	Y-483	7470 ± 130
III. *North American geology and archeology*		
A. *Glacial geology*		
Bellevue Whittlesey. Spruce wood fragments imbedded in beach sediments of glacial Lake Whittlesey, 4.5 mi southeast of Bellevue, Ohio. Collected in 1953 and submitted by R. P. Goldthwait. *Comment*: this critical sample dates the Lake Whittlesey beach in the Lake Erie basin, a stage that resulted from readvance of the ice margin to the Port Huron moraine. It should therefore be of the same age as sample W-140 (12,650 ± 350 yr) (*22*), which dates the Glenwood phase of Lake Chicago. Sample W-33 (13,600 ± 500 yr) (*20*) should be slightly older because it dates the transition from Lake Arkona to Lake Whittlesey.	Y-240	12,800 ± 250
Opasatika River, Ontario. Organic portion of shell-and-wood sample from depth of 6 ft in 14-ft section of marine silty sand, overlying marine clay, described previously (*3*) as dating the post-glacial marine overlap in the James Bay region. *Comment*: the shell date (sample Y-271, 17,000 ± 370 yr) was obviously false; the organic-carbon date also appears to be too old, possibly because at least part of the organic material was older than the deposit in which it was stranded.	Y-271B	11,440 ± 450
Bald-Headed Hills, Manitoba. Wood from vertical stump, rooted in a fossil soil with a 12-in. humified zone and found in sand of active dunes, on Assiniboine delta of Lake Agassiz, 28 mi east and 12 mi south of Brandon. The dunes have been active since A.D. 1740 at least, and the fossil soil is believed to represent an earlier interval of humid climate. Collected in 1955 by R. D. Bird and submitted by J. A. Elson; his number: C-55-3. *Comment*: there are at least two buried soils in the district, and the date suggests that this sample came from a younger horizon than was supposed.	Y-410	Modern
Lavenham, Manitoba. Wood, buried at 12- to 13-ft depth, overlying clayey sand and overlain by 8 to 9 ft of stratified sand and silt containing snails and wood fragments, at about 1050-ft altitude on Lonsbury farm, NW¼ sec. 22, T.9, R.10, W Prin., 2 mi south and 1.2 mi west of Lavenham. The deposit is interpreted as alluvium, laid down in a ravine during the rising stage of Lake Agassiz II. Collected in 1955 by J. A. Elson, Alan Mozley, and R. D. Bird, and submitted by J. A. Elson; his number: C-55-4. *Comment*: this date is reasonably consistent with that of sam-	Y-411	10,550 ± 200

Description	Sample No.	Age
ple Y-165 (12,400 ± 420 yr) (*3*) as a date for Lake Agassiz II, confirming its correlation with the Valders advance.		
Treesbank, Manitoba. Wood from base of 15-ft layer of silty sand containing bones (bison?) and wood, underlain by till and by 8 to 10 ft of gravel and sand deposited on eroded surface of till; overlain by about 25 ft of sand containing a fossil soil horizon and eolian at the surface. Section exposed at 1100- to 1125-ft altitude on the north bank of the Assiniboine River about 1 mi east of (down-stream from) the mouth of the Souris River, NE¼ sec. 15, T.8, R.16, W. Prin., 2 mi north and 2 mi east of Treesbank. The wood-bearing sand was tentatively interpreted as part of the Assiniboine delta laid down in Lake Agassiz I. Collected in 1955 by J. A. Elson, S. Criddle, and R. D. Bird, and submitted by J. A. Elson; his number: C-55-13a.	Y-415	9110 ± 110
Stockton, Manitoba. Peat with wood fragments from a 4-ft bed, underlain by till and by 17 ft of sand and gravel, overlain by 25 ft of sand containing fossil soil horizons. Section exposed at about 1140-ft altitude on the north bank of the Assiniboine River, NE¼ sec. 36, T.7, R.15, W. Prin., 2 mi north and 2 mi east of Stockton. The sand inclosing the peat bed was interpreted as part of the Assiniboine delta laid down in Lake Agassiz I, and should be approximately contemporary with sample Y-415. Collected in 1955 and submitted by J. A. Elson; his number: C-55-11. *Comment*: samples Y-415 and Y-416 are consistent with each other, as expected. Field evidence permits the alternative interpretation, supported by the post-Valders-maximum dates, that the alluvium was graded to a high stage of Lake Agassiz II.	Y-416	8020 ± 100
Ashville, Manitoba. Peat from 4-in. layer at the base of a shallow bog, overlying stony clay in a lagoon behind a beach ridge of Lake Agassiz, at about 1260-ft altitude 51°10'N latitude, 100° 15'W longitude, 5 mi south of Ashville. The bog is believed to postdate Lake Agassiz I because of its altitude (above the highest level of Lake Agassiz II). Collected in 1955 and submitted by J. A. Elson; his number: C-55-14. *Comment*: the date, although disappointingly remote from that of Lake Agassiz I, may be of value in current studies of pollen stratigraphy. Contamination by rootlets is distinctly possible.	Y-418	1400 ± 80
Parker, S.D. Spruce wood (identified by W. L. Stern) from 26-ft depth in a well, NW¼NW¼ sec. 28, T99N, R53W, near Parker. The inclosing sediment is Wisconsin till that had been mapped by R. F. Flint as of late Cary age. Collected by H. A. Mateer and C. A. Avery; submitted by R. F. Flint. *Comment*: the date agrees with dates of samples from similar stratigraphic positions in Iowa (samples C-596, 11,952 ± 500 yr, and C-653, 12,200 ± 500 yr) (*29*).	Y-452	12,330 ± 180
Meriden Airport, Conn. Tamarack wood (identified by W. L. Stern) from a 3½-ft log imbedded in till at the base of a section overlying bedrock at Meriden Airport, near Meriden. Collected by Penelope Hanshaw; submitted by R. F. Flint. *Comment*: although this is the oldest sample yet given a finite date by our laboratory, there is little doubt that its radioactivity is real; of eight measurements on two separate preparations, only one differed from the average background by less than 4 times the standard error of the background.		
Untreated wood.	Y-451A	32,300 ± 4000
Wood, boiled in alkali.	Y-451B	32,000 ± 3000
		Average 32,000 ± 2800
B. *Pollen stratigraphy*		
Shady Valley, Tenn. Sandy peat from 5½- to about 5-ft depth in the spruce-pollen zone of a bog at Shady Valley, Johnson County. Seven peat-borer samples were taken between 4½- and 5½-ft depths, and their lower portions were combined. The pollen diagram (*30*) shows that this level is at the top of a zone of abundant spruce pollen and that it underlies the hemlock-oak zone. It coincides with a minimum in the curves for oak and hemlock, and with maxima in the curves for spruce, fir, and birch. Collected in 1955 by Frank Barclay and submitted by Paul B. Sears.	Y-287	9500 ± 150
Totoket Bog, Conn. Gyttja samples from a boring made with a 2-in. Livingstone borer through the lower part of Totoket bog, North Branford. The pollen stratigraphy was studied by Deevey (*31*) and correlated with the sequence of Leopold (*32*). Of four 1-m cores sampled, one (second from bottom, 7.0 to 8.0 m) incorporated anomalously young material, as proved by radiocarbon dates as well as by pollen, and has been rejected pending further study. Sample Y-285 (13,550 ± 460 yr) (*3*) came from zones A 1 and 2 in another boring at this locality (*32*). Collected in 1956 by E. S. Deevey, R. F. Flint, and Donald MacVicar, and submitted by Deevey.		
Gyttja from zone B (pine pollen maximum), 5.98 to 6.09 m.	Y-446g	9650 ± 90
Gyttja from zone A 4 (upper part of Durham spruce zone) 6.40 to 6.50 m.	Y-446f	12,080 ± 300
Gyttja from zone A 3 (pine-oak-spruce), 6.65 to 6.75 m.	Y-446e	13,870 ± 210
Gyttja from zones A 1 and 2 (lower part of Durham spruce zone), 7.00 to 7.10 m.	Y-446d	14,790 ± 160
Gyttja from zone T 1 (older herb zone), 8.25 to 8.30 m, overlying sand.	Y-446a	15,090 ± 160
Red Maple Swamp, Conn. Gyttja samples from a complete boring made with a 2-in. Livingstone borer through Red Maple Swamp, Connecticut Arboretum, Connecticut College, New London. Pollen stratigraphy was studied by Beetham (*33*) and correlated with the Totoket sequence of Leopold (*32*). The lowermost zones (T 1 to 3) contained too much inorganic material		

Description	Sample No.	Age
for dating. Collected in 1956 and submitted by Nellie Beetham and W. A. Niering.		
Gyttja from zone A 4 (upper part of Durham spruce zone) 4.00 to 4.10 m.	Y-447e	10,480 ± 140
Gyttja from zones A 1 and 2 (lower part of Durham spruce zone) 5.20 to 5.30 m.	Y-447d	13,290 ± 120
Lake Irene, Quebec. Gyttja from 5.75- to 6.00-m depth, overlying clay, in section through deposits of Lake Irene, Chibougamau district, west-central Quebec. Pollen zone 2a of Ignatius (*34*) (birch-spruce, correlated with pine-pollen zone of more southern localities). Collected in 1952 and submitted by Heikki Ignatius. *Comment*: sample Y-222 (6730 ± 200 yr) (*3*) also came from Ignatius' zone 2a in a bog in the Cochrane district, Ontario.	Y-223	6960 ± 90
C. *Five-Mile Rapids archeologic site, Oregon*		
Five-Mile Rapids, pre-Condor level. Charcoal from "Early I" culture layer, containing stone tools, mostly percussion-flaked, overlying fill of Columbia River at the head of Five-Mile Rapids, about 5 mi east of The Dalles (site WS-4). The sampled layer is partly waterlaid and ranges from sterile fill to the condor-bone level, 87.30 to 89.37 m (arbitrary datum, 100 m); it contained deer, carnivore, rodent, and fish bones, and shells of snails including *Lymnaea palustris* (Muller) and *Gyraulis parvus vermicularis* (Gould). Excavated in 1955 and submitted by L. S. Cressman; his sample number: I.	Y-340	9785 ± 220
Five-Mile Rapids, Condor level. Charcoal from "Early II" culture layer, 89.37 to 90.47 m, at the Five-Mile Rapids site. The artifacts are more numerous and more diversified than they are in layer I, including bola stones, atlatls, burins, and retouched lamellar flakes, as well as flaked stone tools; the fauna includes many birds, including condor and the extinct vulture *Coragyps occidentalis* Miller, as well as fish and terrestrial and marine mammals, but no mollusks. Sedimentation was cultural and subaerial, not fluviatile. Excavated in 1955 and submitted by L. S. Cressman; his sample number: II.	Y-341	7675 ± 100
Five-Mile Rapids, bottom of hardpan. Charcoal from "Transitional" culture layer, 90.80 to 91.08 m, at the Five-Mile Rapids site. Human occupation was less intensive than before and shows evidence of culture change, including pressure flaking; the fauna includes a few birds and fish and more terrestrial mammals. Noncultural sedimentation of the immediately preceding fill was subaerial and rapid. A layer of hardpan caps the latter, between 91.08 and 93.27 m at the measured section. Excavated in 1955 and submitted by L. S. Cressman; his sample number: III.	Y-342	7875 ± 100
Five-Mile Rapids, top of hardpan. Charcoal from "late" culture layer, in top of and immediately above hardpan, 93.27 to 93.80 m, at the Five-Mile Rapids site. Human occupation was more intensive than during the period represented by the hardpan stratum or that immediately preceding it, but bones were evidently no longer discarded in the site. The undisturbed surface of site at this point was approximately 4 m higher. Excavated in 1955 and submitted by L. S. Cressman; his sample number: IV.	Y-343	6090 ± 80
Five-Mile Rapids, 1953, pit 2. Charcoal from between 93.16 and 92.76 m, pit 2, 1953, at the Five-Mile Rapids site. Submitted by L. S. Cressman for purposes of cross-dating with materials from the 1954 and 1955 excavations; his sample number: 1953/II.	Y-345a	2395 ± 80
D. *Mexico*		
La Fragua. Organic fraction of marl-gyttja from 20.80 to 21.00 m depth in core 141/I/1L6, La Fragua, D. F. This level is tentatively correlated with the same level (about 20 m) in the Bellas Artes core (*35*). Collected in 1955 by Leonardo Zeevaert and submitted by Paul B. Sears. *Comment*: if the correlation between Bellas Artes and La Fragua cores is accepted, either the date of sample W-50 (4900 ± 250 yr) (*20*) is too young, or the date of sample Y-291 is too old. Sample W-50 was calcareous and may be less reliable than the present measurement. On the other hand, the subsidence of strata under Mexico City introduces serious difficulties of correlation, and the conflict cannot be resolved without further work.	Y-291	> 30,900
Lagunas de Zempoala. Peat from base of 3-m deposit, overlying gravel, at Las Lagunas de Zempoala, D.F. Pollen stratigraphy (*36*, Fig. 3) shows that the level represents a dry phase preceding the last moist phase, which is correlated with that of post-Classic (Toltec, Nahua) time. Predicted date, A.D. 500–1200. Collected in 1955 and submitted by Paul B. Sears.	Y-292	1040 ± 70
E. *Miscellaneous.*		
Follins Pond, Mass. Wood from post, suspected to be shoring for a Viking ship, excavated by Massachusetts Archaeological Society at Follins Pond, Cape Cod. Submitted in 1954 by Frederick J. Pohl. *Comment*: a sample of this wood was found to be modern by the Lamont laboratory (*37*), but since it was measured by the solid-carbon method, the possibility of radioactive contamination could not be excluded.	Y-268	Modern
IV. *Caribbean and South American archeology*		
A. *Paleo-Indian*		
El Jobo, Venezuela. Charcoal from surface deposits of refuse at El Jobo, Sanjón Malo, Estado Falcón. Collected in 1956 by J. M. Cruxent and submitted by Irving Rouse. *Comment*: this is the first Paleo-Indian type of culture discovered in northern South America (*38*). The obviously intrusive nature of the samples is attributed to deposition of charcoal on the eroded refuse by modern inhabitants. A more accurate idea of the probable age of the El Jobo		

Description	Sample No.	Age
culture can be obtained from the following date (Sample Y-228), since the El Jobo projectile points appear to be similar to those at Intihuasi Cave.		
Charcoal from locality CX391.	Y-438	Modern
Charcoal from locality CX348.	Y-439	Modern
Intihuasi Cave, Argentina. Burned bone from a hearth in layer 4, quadrat E, associated with implements of the Ayampitín culture, the older of two preceramic occupations in Intihuasi Cave, 76 km north of San Luis, San Luis Province. The underlying layers (layers 5 to 7) include volcanic ash, cemented gravel and sand, and Pampean loess, with mammal bones but no artifacts; the overlying layers (layers 1 to 3) are cultural refuse from two preceramic cultures (Ayampitín and Ongamirense) and the protohistoric San Luis culture, plus some volcanic ash, and are capped by recent guano (layer 0). Excavated in 1951 and submitted by A. R. Gonzalez.	Y-228	7970 ± 100
B. *Neo-Indian: east coast of Venezuela.*		
La Aduana. Charcoal from La Aduana site 1, Cubagua Island, Estado Nueva Esparta. Manicuare culture, period I. Collected in 1955 by I. Rouse and J. M. Cruxent and submitted by Rouse. *Comment*: the two La Aduana samples agree with those previously obtained for the Ortoire culture (samples Y-260-1, 2750 ± 130 yr, and Y-260-2, 2760 ± 130 yr) (*3*) in providing dates for period I (the preceramic period) on the east coast of Venezuela and in Trinidad.		
Charcoal from 2.00- to 2.75-m depth in sections A1 to A3.	Y-295	3570 ± 130
Charcoal from northern third of hearth 1, 1.50- to 1.75-m depth, section A1.	Y-296g	3050 ± 80
El Mayal, site 2. Charcoal from 0.50- to 0.75-m depth in test excavation at El Mayal site 2, Carúpano, Estado Sucre. El Mayal style, period II. Collected in 1955 by Irving Rouse and J. M. Cruxent and submitted by Rouse. *Comment*: a date of 1800 yr had been predicted for this sample, on the assumption that it corresponds to the time when the Island Arawak separated from the mainland Arawak language, which had been calculated as A.D. 150 by the method of glottochronology (*39*). The correspondence is remarkably close.	Y-297	1795 ± 80
El Mayal, site 1. Charcoal from 0.25- to 0.50-m depth in test excavation at El Mayal site 1, Carúpano, Estado Sucre. Chuare style, period III. Collected in 1955 by Irving Rouse and J. M. Cruxent and submitted by Rouse.	Y-300	1355 ± 80
El Morro. Charcoal from 0.20- to 0.80-m depth in test excavation at El Morro site, Rio Caribe, Estado Sucre. El Morro style, period IV. Collected in 1955 by Irving Rouse and J. M. Cruxent and submitted by Rouse.	Y-298	715 ± 70
Calle de la Marina. Charcoal from 0.40- to 0.75-m depth in test excavation on Calle de Marina, Rio Caribe, Estado Sucre. El Morro style, period IV. Collected in 1955 by Irving Rouse and J. M. Cruxent and submitted by Rouse. *Comment*: all the dates in the east-coast group agree nicely with the relative chronology previously established for this part of Venezuela (periods I to IV); they are in the proper order and fairly well spaced (*8*, Fig. 2).	Y-299	290 ± 70
C. *Neo-Indian: Orinoco basin, Venezuela*		
Saladero. Charcoal from 0.75- to 1.25-m depth in test pit at the western end of the Saladero site, Barrancas, Estado Monagas. Barrancas style, period II to III. Collected in 1955 by Irving Rouse and J. M. Cruxent and submitted by Rouse.	Y-294	2800 ± 150
Saladero. Charcoal from 1.25- to 1.50-m depth, excavation 6, Saladero site, Barrancas, Estado Monagas. Barrancas style, period II to III. Collected in 1950 by Irving Rouse and J. M. Cruxent and submitted by Rouse. *Comment*: a previous date for the Barrancas style (sample Y-40, 2850 ± 120 yr) (*3*) was questioned because it conflicted with the relative chronology. The Barrancas style had been placed in the latter part of period II and the first half of period III in the relative time scale, but this radiocarbon date made it contemporaneous both with the preceramic, period I sites on the coast and in Trinidad (see comment on samples Y-295 and Y-296g) and with the Saladero style of pottery on the lower Orinoco, which was supposed to date from the first half of period II. Because of these discrepancies, Rouse and Cruxent obtained a new sample for the Barrancas style (Y-294) and submitted another sample previously obtained (Y-316). The dates for the two new samples confirm the original date and indicate that both the Saladero and Barrancas styles of pottery were on the lower Orinoco at a time when the Indians of the east coast of Venezuela were still preceramic. In other words, both the Saladero and the Barrancas styles must be assumed to go back to the latter part of period I in the coastal chronology (*8*, Fig. 3).	Y-316	2820 ± 80
D. *Neo-Indian: miscellaneous*		
Chaviña, Peru. Textile from a mummy, found in an adobe-box grave at Chaviña, on the southern coast, and assigned on basis of pottery styles to the end of the Nazca (late Classic) culture. Predicted date, A.D. 700–800. Collected and submitted by S. K. Lothrop.	Y-126	1320 ± 60
V. *Southern Hemisphere*		
A. *Australia*		
Mowbray Swamp, Tasmania. Peat and marl from deposit of Mowbray Swamp, Shoobridge farm, Mella, near Smithton, northwestern Tasmania. The deposit contains ostracods, gastropods, and lamellibranchs, as well as extinct vertebrates (*Nototherium*), and was suspected to be a correlative of Pyramid Valley Swamp, New Zealand (*1*). However, more recent study of the pollen shows that the climatic conditions		

Description	Sample No.	Age
were those of open country, and assignment to an interglacial stage (Sangamon?) is now considered possible (*40*). Collected in 1952 and submitted by E. D. Gill. *Comment*: the peat was expected to give a younger apparent age than the marl, as at Pyramid Valley, but the great age of both leaves the difference between them unspecified.		
Marl from about 2-ft depth.	Y-148-1	> 37,760
Peat from 2- to 4-ft depth, underlying wood.	Y-148-2	> 37,760
Pulbeena Swamp, Tasmania. Peat and marl in a drain through deposit of Pulbeena Swamp, near Pulbeena railroad station, northwestern Tasmania. Pollen studies show vegetation indicative of climate as moist as or moister than that of the present; fossil mollusks and ostracods indicate no important difference between the deposit and that of Mowbray Swamp, 2 mi away. Collected in 1952 and submitted by E. D. Gill. *Comment*: the greater age of the marl may be real, but probably reflects in part the incorporation of older carbon from limestone in the vicinity.		
Peat from 2-ft to 2-ft 7-in. depth, underlying 1 ft 5 in. of marl.	Y-229-1	13,690 ± 550
Marl from 5½-ft depth in the same section.	Y-229-2	27,900 ± 2000
Lake Colongulac, Victoria. Coxiella (inland water) shells from the type locality of *Thylacoleo carnifex* Owen, underlying loess and volcanic tuff on east shore of Lake Colongulac, western Victoria. The deposit contains fossils of several extinct gigantic marsupials; a bone of one of these, believed to have been worked by man, was found *non in situ*, but has the same fluorine index as the extinct marsupials (*41, 42*). Collected in 1952 and submitted by E. D. Gill.	Y-170	13,700 ± 250
Lake Corangamite, Victoria. Coxiella shells sifted from fossil dune 40 ft above the eastern shore of Lake Corangamite, near Cundare, western Victoria (military map 1959, Beeac sheet, grid references 628, 956). The dune was formed during Australia's "Great Arid Period," postdating the deposits containing gigantic marsupials. Although the aquatic snails were not contemporary with the desiccation, but were blown into the deposit from dried-up pools on the floor of the basin, it was hoped that the difference in age would not be great. Collected in 1953 and submitted by E. D. Gill. *Comment*: redeposition of the shells makes this an impossible date for the arid phase.	Y-230	28,240 ± 1100
Yarra Delta, Victoria. Eucalyptus wood from 63-ft depth below low water, Spencer Street Bridge, Melbourne. The black marine silt in which the wood was imbedded overlies yellow clay, oxidized subaerially during the last low stand of the sea, and extends above present sea level. The wood dates an early stage in the postglacial marine transgression, which is believed to have been eustatic (*42, 43*). Collected in 1951 and submitted by E. D. Gill.	Y-151	8300 ± 210
Comment: another portion of this specimen (sample W-95) was dated 8720 ± 200 yr (*20*).		
Goose Lagoon, Victoria. Charcoal from an aboriginal midden on the 25-ft emerged shoreline, Goose Lagoon, site B, western Victoria. Collected in 1951 and submitted by E. D. Gill. *Comment*: a similar sample (C-600) was dated 1177 ± 175 yr (*44*).	Y-150-1	1855 ± 85
B. *Africa*		
Nok, Nigeria. Wood from the youngest and oldest alluvium exposed in the Main Paddock (tin mine) on Nok River, near Jos. The youngest alluvium is stratified, with tin-bearing gravels at the base, overlying an erosion surface cut in the older alluvium and overlain by sand and then by clay. The basal gravel of the youngest body contains pottery and figurines and some evidence of metal-working; hence the deposit is thought (*45*) to date from the Nakuran moist phase, which was provisionally dated (*46*) at 850 B.C. The next older alluvium contains Middle Stone Age tools, and is thought to be of Gamblian age, though Leakey (*47*) suggests that it is Makalian. The oldest alluvium contains Acheulian artifacts. Collected by Bernard Fagg and submitted through Hallam Movius. *Comment*: the oldest specimen was expected to be too old for radiocarbon dating, and was measured to test the possibility of infiltration of younger carbon into wood from alluvium at this tropical locality. The first sample of wood from the basal gravel (sample Y-142-3, Nok C), which was measured twice to insure against mixture of samples, is too old to be Nakuran, and must have been redeposited from older (presumably Makalian) sediments. This conclusion is supported by the similar age of the Zenebi sample (Y-142-7) and suggests that the Middle Stone Age may have survived into the Makalian interval in this part of Africa. The three younger samples confirm the belief that the Nok figurine culture began within the Nakuran moist phase and bracket its date between about 2000 B.C and A.D. 200, with the most probable date being that of Y-142-4, about 900 B.C.		
Nok G, wood with bark adhering, from black clay overlying sand and gravel of the youngest alluvial body, 1956 excavation.	Y-474	1750 ± 50
Nok D, wood from sand overlying basal gravel of the youngest alluvial body, 1951 excavation.	Y-142-4	2875 ± 70
Nok H, carbonized wood from sand and gravel at the main figurine horizon, overlying basal gravel of the younger alluvial body, 1956 excavation.	Y-475	4060 ± 140
Nok C, wood from basal tin-bearing gravel, at main figurine horizon, overlying erosion surface cut in older alluvium, 1951 excavation.	Y-142-3	5490 ± 85
Nok C, another portion of the same specimen, sent separately.	Y-142-3′	5660 ± 90
Average age of Nok C.		5575 ± 65
Nok E, carbonized wood from oldest	Y-142-8	> 39,000

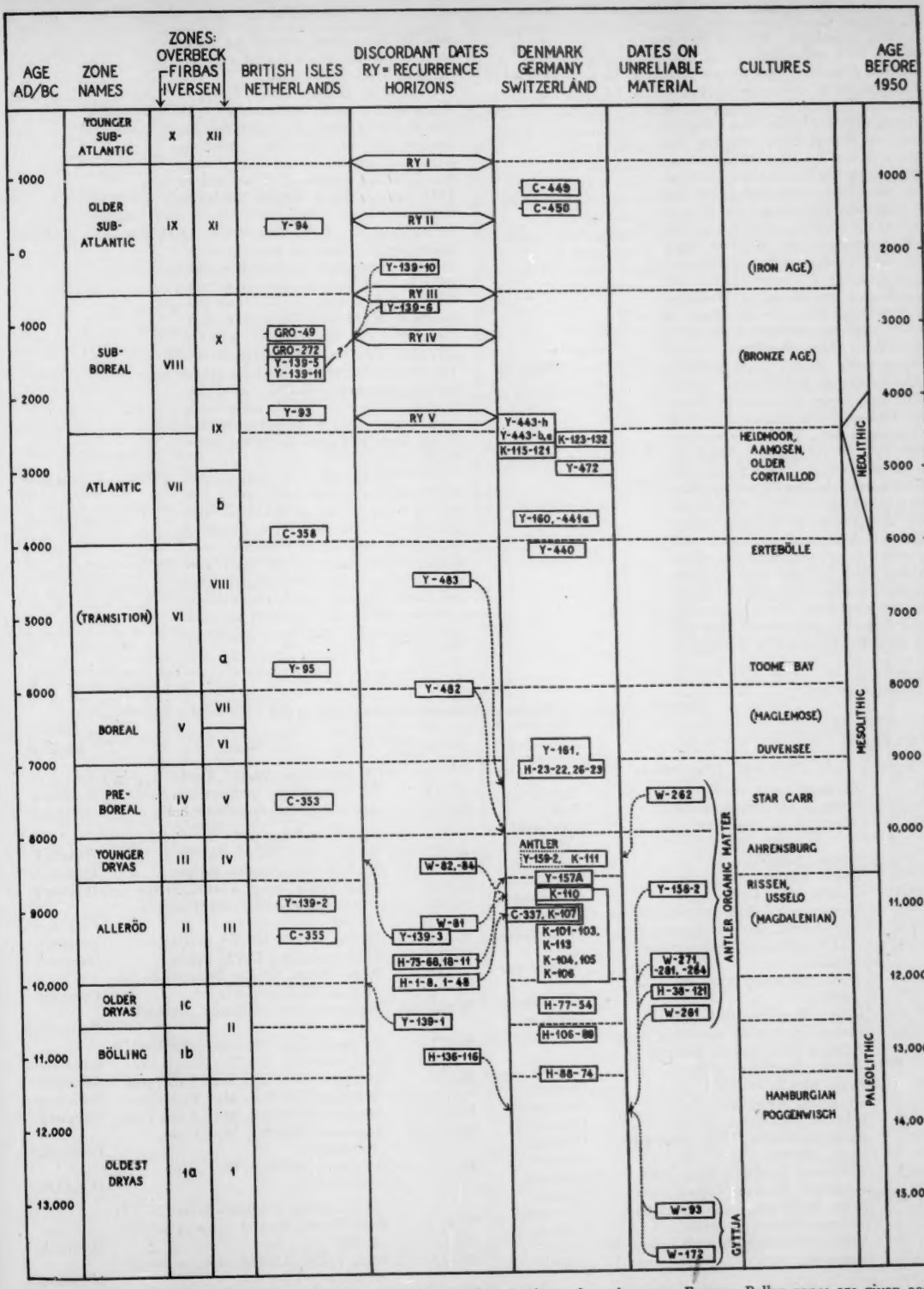

Fig. 1. Summary of radiocarbon-calibrated pollen chronology and archeology of northwestern Europe. Pollen zones are given according to Schmitz (*25*), with chronologic boundaries as modified by radiocarbon dates. Y, Yale dates (this article); C, Chicago dates (*12*); K, Copenhagen dates (*19, 52*); W, Washington dates (*20–22*); H, Heidelberg dates (*18, 53*); GRO, Groningen dates (*54, 55*). Samples are listed by number and name in Table 1.

Description	Sample No.	Age
alluvium, associated with Acheulian artifacts, 1951 excavation.		
Zenebi, Nigeria. Wood from a large log imbedded in older tin-bearing alluvium in Zenebi No. 1 Paddock, associated with a Middle Stone Age industry, on Zenebi River near Jos. The deposit is cut by an erosion surface, above which lies the younger alluvium. It is tentatively correlated (*45*) with the Gamblian pluvial age on the evidence of the artifacts. Collected in 1948 by Bernard Fagg and Geoffrey Bond and submitted through Hallam Movius; Fagg's specimen Z. *Comment*: the date suggests that the deposit is Makalian, not Gamblian. There is no reason to suspect that the artifacts were redeposited from older alluvium.	Y-142-7	5440 ± 110
Njoro Cave, Kenya. Charcoal from several graves at the Neolithic crematorium site, Njoro rock shelter, Kenya (*48*). Collected and submitted by L. S. B. Leakey through W. F. Libby. *Comment* (by L. S. B. Leakey): "It is uncertain whether the rock shelter was formed during the first part of the Nakuran wet phase or before it, but certainly any archaeological content in it would have been removed had it been in position before the maximum of the Nakuran moist climatic phase. Consequently, the culture found in the graves and cremations must postdate the peak of the Nakuran wet phase. This had been provisionally dated as 850 B.C. In view of the carbon dating the maximum of the wet phase is probably earlier than originally thought."	Y-91	2920 ± 80
Cape Flats, Cape Province, Union of South Africa. Podocarp wood from 20 ft below the surface of a sandy deposit, forming part of Cape Flats, the low-lying area separating the Cape Peninsula from the mainland. Submitted in 1951 by the South African Museum, Capetown.	Y-49	> 38,000
Crawford, Cape Province, Union of South Africa. Podocarp wood from 27 ft below the surface of a 70-ft terrace (*49*) forming part of Cape Flats, near Crawford. Collected in 1951 and submitted by E. M. van Zinderen Bakker. *Comment*: the 70-ft terrace is probably older than the last interglacial age. The two measurements cast no doubt on the supposition that the wood belongs to the terrace, but do not provide an adequate date for the last separation of the Cape Peninsula from the mainland.	Y-106	> 36,300
Florisbad, Orange Free State, Union of South Africa. Peat from layer I, 600 cm, inclosing a skull of Florisbad man, the oldest of four peat layers overlying bedrock in the cave of Florisbad, near Bloemfontein. Collected in 1951 and submitted by E. M. van Zinderen Bakker. *Comment*: this level has been dated (sample C-850) as > 41,000 yr (*50*) and (sample L-271B) as > 35,000 yr (*51*).	Y-103	> 44,000

Table 2. Checklist of European radiocarbon dates shown in Fig. 1.

Sample No.	Name	Location
	Yale dates (this article)	
Y-93	Clonsast, early sub-Boreal	Eire
Y-94	Clonsast recurrence horizon	Eire
Y-95	Toome Bay, Mesolithic	Northern Ireland
Y-139-1	Usselo, Alleröd	Netherlands
Y-139-2	Usselo culture	Netherlands
Y-139-3	Usselo, upper Dryas	Netherlands
Y-139-5	Vriezenveen, below recurrence horizon	Netherlands
Y-139-6	Vriezenveen, above recurrence horizon	Netherlands
Y-139-10	Oud-Loosdrecht, above recurrence horizon	Netherlands
Y-139-11	Oud-Loosdrecht, below recurrence horizon	Netherlands
Y-157A	Rissen, Magdalenian hearth	Germany
Y-158-2	Meiendorf, organic fraction of antler	Germany
Y-159-2	Stellmoor, Ahrensburg culture, organic fraction of antler	Germany
Y-160	Rüde, Mesolithic, 1951	Germany
Y-161	Duvensee, Mesolithic	Germany
Y-440	Ellerbek, Mesolithic	Germany
Y-441a	Rüde, Mesolithic, 1955, lower part	Germany
Y-442	Lieth, Alleröd	Germany
Y-443b,h	Heidmoor, Neolithic, lower level	Germany
Y-443e	Heidmoor, Neolithic, upper level	Germany
Y-471	Rüde, Mesolithic, 1955, upper part	Germany
Y-472	Südensee-Damm, Neolithic	Germany
Y-482	Varrassuo, post-Salpausselkä, zone III	Finland
Y-483	Varrassuo, post-Salpausselkä, zone IV	Finland
	Chicago dates (12)	
C-337	Wallensen, Alleröd, gyttja	Germany
C-353	Star Carr, Mesolithic, wood	England
C-355	Knocknacran, Alleröd, gyttja	Eire
C-449	Melbeck, above recurrence horizon	Germany
C-450	Melbeck, below recurrence horizon	Germany
	Copenhagen dates (19, 52)	
K-101–103	Ruds Vedby, end of Alleröd, gyttja	Denmark
K-104,105	Ruds Vedby, Alleröd, gyttja	Denmark
K-106	Ruds Vedby, lower Alleröd, gyttja	Denmark
K-107	Wallensen, Alleröd, checks sample C-337	Germany
K-110	Bölling, end of Alleröd, gyttja	Denmark
K-111	Bölling, younger Dryas, gyttja	Denmark
K-113	Ruds Vedby, Alleröd, between K-101-103 and K-104, gyttja	Denmark
K-115, 116, 118	Wauwilermoos, Neolithic, Egolzwil 3 site, wood	Switzerland
K-121	Wauwilermoos, Neolithic, Egolzwil 3 site, charcoal	Switzerland
K-123	Aamosen, Neolithic, Mul. I site, peat	Denmark
K-124–126	Aamosen, Neolithic, Mul. I site, bark	Denmark
K-127	Aamosen, Neolithic, Mul. I site, peat	Denmark
K-128,129	Aamosen, Neolithic, Mul. I site, hazelnuts	Denmark
K-131,132	Aamosen, Neolithic, Mul. I site, charcoal	Denmark
	U.S. Geological Survey dates (20–22)	
W-81	Ruds Vedby, Alleröd, same as sample K-102	Denmark
W-82,84	Ruds Vedby, Alleröd, same as sample K-101	Denmark
W-93	Poggenwisch, Hamburgian culture, marl-gyttja	Germany
W-172	Meiendorf, Hamburgian culture, marl-gyttja	Germany

Sample No.	Name	Location
W-261	Stellmoor, Hamburgian culture, antler	Germany
W-262	Stellmoor, Ahrensburg culture, antler, same as sample Y-159-2	Germany
W-264	Meiendorf, Hamburgian culture, antler	Germany
W-271	Poggenwisch, Hamburgian culture, antler	Germany
W-281	Meiendorf, Hamburgian culture, organic fraction of antler, same as sample Y-158-2	Germany
	Heidelberg dates (18, 53)	
H-1-8, 1-48	Wallensen, Alleröd, checks samples C-337 and K-107	Germany
H-18-11	Rissen, Magdalenian, wood	Germany
H-23-22	Duvensee, Mesolithic, birchwood	Germany
H-26-23	Duvensee, Mesolithic, hazelnuts	Germany
H-38-121	Meiendorf, Hamburgian culture, organic fraction of antler, same as samples W-281 and Y-158-2	Germany
H-75-68	Rissen, Magdalenian, charcoal, same as sample Y-157A	Germany
H-77-54	Gaterslebener See, 280 to 290 cm, beginning of older Dryas, zone Ic, wood	Germany
H-88-74	Gaterslebener See, 370 to 380 cm, beginning of Bölling, zone Ib, wood	Germany
H-106-89	Gaterslebener See, 367 to 377 cm, beginning of Bölling, zone Ib, wood	Germany
H-136-116	Poggenwisch, Hamburgian culture, wood	Germany
	Groningen dates (54, 55)	
GRO-272	Corlona, Bronze Age trackway, wood	Eire
GRO-49	Halve-Mijl-Toterfout, tumulus 8, Bronze Age, charcoal	Netherlands

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News of Science

Stagnant Deep-Sea Trench to be Studied

Research workers from the Woods Hole Oceanographic Institution recently left Woods Hole in the research vessel *Atlantis* to study a trench in the Caribbean Sea where the deep water is not in motion. Called the Cariaco Trench, the 4680-foot-deep basin is located near the coast of Venezuela. Shut off from the rest of the sea by a sill that permits no ocean water to enter from depths greater than about 500 feet, the trench contains stagnant water in which there is no free oxygen. Similar areas have been known to exist in the Black Sea and in some fjords but had never before been encountered in the open sea until 3 years ago, when the *Atlantis* research team reported the situation in the Cariaco Trench.

Of particular interest is the fact that petroleum is thought to have been laid down under similar anaerobic conditions. Higher forms of life are not possible, and the organic material sinking from surface waters is decomposed by bacteria; a layer of organic material is thus deposited on the bottom of the trench, and inorganic compounds which cannot return to the surface to aid plant growth are released.

Forty-foot cores of sediment will be obtained from the bottom of the trench under the direction of submarine geologist John M. Zeigler, while chemical oceanographer Francis A. Richards will be in charge of the chemical studies of the ocean water. The cruise is supported by funds from the Office of Naval Research. An underwater camera capable of making three-dimensional photographs of the bottom will be used by photographer David M. Owen. The scattering of light in the sea will be measured by David H. Shonting, and Vaughan T. Bowen will obtain large quantities of sea water from various depths for analysis of radioactive elements.

A bottom probe designed to measure the heat-flow from the earth's interior through the bottom sediment also will be tried out by Richard G. Leahy. This probe will be taken next spring to the IGY arctic ice-floe station A. In addition, a continuous profile of the ocean bottom's configuration will be made with the aid of an echo-sounder recorder.

Finally, workers in a fishing program under Herman Tasha will set out a Japanese long-line containing 80 hooks at mid-depths in various places in the Caribbean and in the Windward Passage between Cuba and Hispaniola. Large quantities of tuna have recently been reported off Venezuela. A large deep-freeze has been placed on the deck of the *Atlantis* to bring specimens back to Woods Hole for identification.

Frank J. Mather of the institution's game fish program believes that some of the bluefin tuna reported from the area may turn out to be bigeye tuna. The latter species was not known west of the Azores until 1955, when Mather and H. Bullis identified a bigeye in the Caribbean. Since that time the species has also been identified near Miami and at Ocean City, Md.

The *Atlantis* will return to Woods Hole on 2 December, when she will immediately be made ready for a 7-month cruise to the South Atlantic Ocean and the Indian Ocean under the IGY program.

Nominations for Nutrition Awards

The American Institute of Nutrition invites nominations for the 1958 Borden Award in Nutrition and the 1958 Osborne and Mendel Award for research in nutrition. Nominations may be made by anyone and must be submitted *by 1 January 1958* to the chairman of the appropriate nominating committee. Membership in the American Institute of Nutrition is not a requirement for eligibility, and there is no limitation as to age. For full details about the procedure for nomination, see the September and October issues of the *Journal of Nutrition*.

Radioactive Fallout on Farmland

Farm land at Compton in Berkshire, England, was made temporarily radioactive recently to simulate contamination from a nuclear bomb explosion; farm hands carried out their work in respirators and suits of polythene. The whole area was sealed off with a chain-link fence, and even tractors and farm implements were fitted with plastic covers.

The tests were designed to find out how much radioactive strontium would be taken up from the soil by various crops sown on land that had been subject to radioactive fallout, and what different methods of cultivation affected the amount taken up. The trials, which took place at the Agricultural Research Council Field Station, involved the spraying of the ground (chalk soil) with radioactive strontium 89.

The results published so far suggest that where the soil has a marked calcium deficiency, liming can reduce a plant's absorption of strontium, but that, apart from this, little can be done to bring contaminated land into safe use quickly. Some advantage, however, might be gained by choosing crops less affected by radioactivity, and there is a chance that uptake might be reduced where shallow-rooted crops are grown on soils that have been deep-plowed in one operation. Similar experiments are to be conducted at five other agricultural research centers, each having a different type of soil.

AAUW International Fellowships

The American Association of University Women offers a number of $2000 international fellowships for the academic year 1958–59. They are unrestricted, but the candidate must use them in a country other than his own. The awards are open to women who have completed residence requirements for the doctorate before 1 July 1958. Application forms may be obtained from Miss Mary H. Smith, AAUW Fellowship Program, 1634 I St., NW, Washington, D.C. The deadline date for submission of applications is *15 December*.

Eklund to Head Second International Conference on Atomic Energy

Sigvard A. Eklund, director of research for the Swedish Atomic Energy Company, Stockholm, has been named secretary-general of the second International Conference on the Peaceful Uses of Atomic Energy that is to held under United Nations auspices in Geneva, Switzerland, 1–13 September 1958. Eklund arrived in New York recently, for in his capacity as conference secretary-general, he will serve as an officer of the United Nations Secretariat.

Plans for the second conference have been made by U.N. Secretary-General Dag Hammarskjold and the Advisory Committee on the Peaceful Uses of

Atomic Energy, composed of representatives of Brazil, Canada, France, India, the U.S.S.R., the United Kingdom, and the United States. The agenda and rules of procedure for the conference were sent earlier this year, along with formal invitations, to all members of the United Nations or of affiliated specialized agencies. Titles and abstracts of papers to be presented at the conference are to be submitted *by 1 March 1958* and the full texts *by 1 June*.

Allergy Fellowships

The American Foundation for Allergic Diseases has announced the availability of 2-year postdoctoral fellowships in research and clinical allergy. The stipend for the first year is $4500; second year, $4750; laboratory and travel expenses for the 2-year period, $750. Candidates must be graduates of approved medical schools and must have completed 1 or 2 years of the graduate training required as a preliminary to certification by the Boards of Internal Medicine or Pediatrics.

Requests for applications should be sent to Dr. Colin M. MacLeod, University of Pennsylvania, 820 Maloney Clinic, 36th and Spruce Streets, Philadelphia 4, Pa. Applications should be filed no later than *15 December*.

Research Support in Engineering Schools

The National Science Foundation reports that in 1953–54 more than one-fourth of the cost of research and development conducted by colleges and universities was spent by engineering schools. Their share of a total of $300 million in research expenditures by academic institutions was $75 million. Of this amount, about $55 million represented government research support, chiefly through contracts with the Department of Defense.

These figures are given in *Funds for Research and Development in Engineering Schools, 1953–54,* which is No. 7 in the NSF series of *Reviews of Data on Research and Development.* Copies of the report may be obtained by writing to the National Science Foundation, Washington 25, D.C.

Berkeley Program for Public Health and the Social Sciences

A new research program designed to acquaint doctoral candidates from the fields of public health and the social sciences with the problems and practices of each other's profession has been established at the University of California, Berkeley. The work will be directed by L. Knutson, former chief of the behavioral studies section in the General Health Services Division of the U.S. Public Health Service, Washington, D.C.

The first participants in the Berkeley program will be four doctoral candidates in public health who will undertake research in behavioral science. There are about 2000 local public health departments in the United States, but there are probably less than 50 public health workers who have been trained at the doctoral level in the behavioral sciences. There is an ever-increasing shortage of this type of public health leader, and this is one of the first programs specifically organized to satisfy the need.

Office of Critical Tables

Guy Waddington, chief of the thermodynamics branch of the U.S. Bureau of Mines Petroleum Experiment Station, Bartlesville, Okla., has been named director of the newly established Office of Critical Tables at the National Academy of Sciences–National Research Council. The new office will seek to make more readily available to science and industry the large quantity of numerical data about the physical properties of chemical substances which are being collected and confirmed by independent research groups in universities, industry, and government.

The independent data-reporting groups will continue to perform the fundamental task of collecting and confirming the essential information. The projected contributions of the Office of Critical Tables are (i) to survey current programs for preparation of critical tables and to determine the need for new tables; (ii) to encourage the reporting groups to provide these tables on a continuing basis (iii) to suggest uniform standards of presentation; and (iv) to maintain a current indexing and directory service.

The contemplated body of information is so vast that—for the present, at least—there are no plans to assemble all data in a single set of volumes. It is anticipated that the total budgets for all cooperating independent groups will approach $1 million a year.

The new operation grew out of a report submitted by an Academy–Research Council committee in 1955. The committee had been asked to assess the practicality of revising the International Critical Tables, a compilation of similar numerical data published as a series of volumes from 1926 to 1933 under the auspices of the NAS–NRC. The report of this initial committee stated that the extent to which recent research had revealed new data, increased the accuracy of current data, and opened up completely new areas of investigation made revision appear unwise. The report also pointed out that there was a need for a new approach to accommodate the accumulation of unorganized data and the multiplicity of publications. The solution offered was the present program of the Office of Critical Tables.

An Executive Committee for the Office of Critical Tables was established under the chairmanship of Allen V. Astin, director of the National Bureau of Standards, to formulate policies for the new enterprise. Representatives were selected from the four divisions of the Academy–Research Council most concerned: chemistry and chemical technology, Frederick D. Rossini of Carnegie Institute of Technology; physical sciences, Robert B. Brode of the University of California; engineering and industrial research, Fred B. Llewellyn of Bell Telephone Laboratories; and earth sciences, Francis Birch of Harvard University. The committee will continue to serve as a policy-making group. (At present the Division of Engineering and Industrial Research is represented by Edgar C. Bain, division chairman.)

Mathematics TV Series

"Adventures in Number and Space" is the title of a new educational TV film series designed to make mathematics interesting to secondary school students. The program, which will start on 10 November, was conceived by the Westinghouse Broadcasting Company and prepared with the cooperation of the department of mathematics at Columbia University Teachers College. It will star Bill Baird and his Marionettes, and will be aimed primarily at junior high school students. The series will first be seen over the WBC TV outlets in Boston, Baltimore, Pittsburgh, Cleveland, and San Francisco, but the films will be made available at no cost to educational TV stations elsewhere.

Physics of Fluids

In January 1958 the American Institute of Physics will publish the first issue of *The Physics of Fluids.* F. N. Frenkiel, of the Applied Physics Laboratory, Johns Hopkins University, will edit the new journal with the aid of an 18-member editorial board. *The Physics of Fluids* will start as a bimonthly and will become a monthly as soon as it appears desirable. The journal will contain original papers on significant research results that have not been reported elsewhere.

Correspondence on editorial matters should be addressed to: F. N. Frenkiel,

The Physics of Fluids, Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Md. Subscription information may be obtained from the American Institute of Physics, 335 E. 45 St., New York 17, N.Y.

South Pole Snow Pit

The International Geophysical Year Committee of the National Academy of Sciences has announced that a snow pit dug at the Amundsen-Scott IGY South Pole Station had reached a depth of 50 feet on 1 October. The pit, which has been dug by hand during the Antarctic winter, serves a dual purpose: the successive levels of snow laid bare provide an unspoiled record of climatic and other history, and the snow itself is melted for the station's water supply.

The snow in the pit is so hard that even saws cannot be used. The snow must be chipped loose with mattocks or ice axes and then shoveled into bags and hauled to the surface. Each man at the station spends a minimum of 2 hours every week either cutting or hauling snow. An 18-degree ramp is maintained to provide access to the pit.

The temperature in the pit is nearly constant at −60°F, while at the surface a record temperature reading of −102.1°F was recorded on 17 September. During the period 11 May to 17 September, South Pole temperatures were lower than −95°F 17 times.

A study of snow stratification, combined with examination of snow crystals and density, yields a history of the Antarctic. For example, traces of ash may indicate that a volcanic eruption took place hundreds of years ago, and pollen deposits provide a clue to past wind systems. Paul Siple is scientific leader at the Pole station, where there are eight other scientists and a similar number of Naval personnel.

New Miniaturization Award

Miniature Precision Bearings, Inc., has announced that entries are now being accepted for the first annual Miniaturization Award, a competition established to recognize outstanding contributions by an individual or firm which further the concept of miniaturization. The award, sponsored by M.P.B., is being administered by an independent committee of specialists representing industry, government, and education.

Award entries are being judged by the following sets of criteria: (i) products, components, or parts which show outstanding ingenuity in solving problems, make use of new design concepts and special materials, and develop new-type components or parts that extend the frontiers of miniaturization; (ii) individuals, companies, or organizations which have broadened the horizons of miniaturization by creating a better understanding and use of the concept through education, research, engineering, and standardization.

Entries outlining contributions toward the concept of miniaturization should be submitted to the Awards Committee, Miniature Precision Bearings, Inc., Precision Park, Keene, N.H.

November Scientific Monthly

Articles appearing in the November issue of *The Scientific Monthly* are as follows: "Measuring Geologic Time," A. Knopf; "Aspects of Insect Flight," B. Hocking; "Vitalistic Mechanistic Controversy," L. F. Koch; "How Adequate Is the World's Food Supply?" R. W. Phillips. Twelve books are reviewed.

News Briefs

A new building that will house the Hunter Radiation Therapy Center, a joint enterprise of Yale University and the Grace–New Haven Community Hospital, is under construction at the Yale–New Haven Medical Center. The building also will provide space for an extension of the existing Laboratory for Medicine and Pediatrics.

* * *

Ground-breaking ceremonies for the new Irene Walter Johnson Institute of Rehabilitation of the Washington University Medical Center were held on 16 October. The structure, which will cost about $725,000, is expected to be completed within 15 months.

* * *

When the Soviet satellite was announced, the Boulder, Colo., division of the National Bureau of Standards was one of the few U.S. laboratories properly instrumented to study its 20- and 40-megacycle radio signals. Boulder scientists had been observing radio energy emitted by the star Cygnus; by an adjustment of equipment, they were able to monitor *sputnik* almost from the outset.

* * *

The Office of Test Information of the Atomic Energy Commission (Nevada Test Organization) at 1235 South Main St., Las Vegas, Nev., has closed. Inquiries about tests and related matters can now be directed to Office of Information, Albuquerque Operations Office, P.O. Box 5400, Albuquerque, N.M.

* * *

Two $5000 fellowships, one for Egyptological studies and one for Islamic studies, are being offered by the American Research Center in Egypt, a nonprofit organization affiliated with the Archaeological Institute of America. Applications must be filed *before 1 March* with Mrs. Elizabeth Riefstahl, Executive Secretary, American Research Center in Egypt, 489 Huntington Ave., Boston 15, Mass.

* * *

Key activities of the International Geophysical Year, such as the study of earth satellites, scientific expeditions to Antarctica, and the coordination of weather data, are described in the September issue of the *Courier*, published by the United Nations Educational, Scientific and Cultural Organization. The entire issue is devoted to the 18-month IGY program.

* * *

Aeronutronic Systems, Inc., a new Ford Company subsidiary on the West Coast, has bought a 200-acre mesa near Newport Beach, Calif., where it plans to build an extensive research and development center. The first unit to be constructed will be a series of aerothermochemical laboratories for the investigation of problems associated with the design of advanced missile systems.

* * *

A study of sensory deprivation is being carried out by the Psychiatry Service of Boston City Hospital, Boston, Mass. Philip Solomon, physician-in-chief in the Psychiatry Service, reports that the research team in his unit would very much like to hear from anyone else doing work on sensory deprivation.

* * *

Texas Instruments Limited, a wholly owned subsidiary of Texas Instruments Incorporated, of Dallas, Tex., has opened its new plant in Bedford, England, for the manufacture of transistors and other semiconductor devices. The plant is the first Texas Instruments manufacturing facility to be established outside the United States.

* * *

The University of Alabama has received title to 136 acres of Government land, valued at $176,000. Approximately 90 acres of the area, which is approximately 3 miles from the main university campus, are to be developed by the biology department into an arboretum that will be used in the department's teaching and research program. E. Gibbes Patton has been named director of the aboretum.

* * *

The U.S. Public Health Service has reported that by the end of this year's poliomyelitis season only 1576 paralytic cases had been reported, compared with 7886 cases in 1955 and 5241 cases last year. This year's total represents an 80 percent reduction in paralytic cases in the past 2 years.

Scientists in the News

A *Festschrift* of scientific articles on medical radiology has been published to honor ROBERT R. NEWELL, who recently became emeritus professor of radiology at Stanford Medical School. More than 20 articles contributed by some 30 colleagues and former students of Newell are contained in a special issue of the *Stanford Medical Bulletin* (August 1957), which also includes a paper on radiation hazards by Newell himself.

Newell retired this fall after 37 years as a member of the Medical School faculty. He was a former head of Stanford's department of radiology, and early this year received the gold medal of the American College of Radiology, the organization's highest honor.

MORRIS S. MACOVSKY has resigned as head of the fluid dynamics branch in the Hydromechanics Laboratory of the David Taylor Model Basin, Washington, D.C., to accept a position as consulting specialist, systems engineering, Sunnyvale, Calif.

MARSHALL C. HARRINGTON, who prior to joining the David Taylor Model Basin 2 years ago was head of the department of physics at Drew University, has been appointed as Macovsky's successor.

JOHN R. GREGG, formerly of Columbia University, has been appointed associate professor of zoology at Duke University. He succeeds GEORGE W. NACE, who has accepted a position in the zoology department of the University of Michigan.

RAGNAR FANGE of the department of zoophysiology, University of Lund, Sweden, will spend a year at Duke working on problems of water balance and salt metabolism as a research associate of Knut Schmidt-Nielsen.

DONALD J. FLUKE, who is at present a research associate in the Donner Laboratory, Berkeley, Calif., and who is on leave from Brookhaven National Laboratory, has been appointed associate professor of zoology at Duke, effective 1 Feb. 1958. During the academic year he will be in charge of the zoological department's training program in biophysics; in the summer he will direct the radiation biology course for high school teachers that is offered annually at the Duke University Marine Laboratory.

CLARENCE M. ZENER, director of research at Westinghouse, will receive the Bingham Medal of the Society of Rheology during its 1957 annual meeting in Princeton, N.J., 7–9 November. Zener is being honored for his work on the viscoelastic behavior of metals.

RAY Q. BREWSTER, research chemist who has taught at the University of Kansas for 38 years, has won the 1957 Midwest Award of the American Chemical Society's St. Louis Section "for his achievements as an outstanding educator, a counselor of students, a research director, an administrator, a textbook writer and as an ambassador of chemistry."

JACK H. SCHULMAN of Cambridge University, England, is the first incumbent of Columbia University's newly established Stanley-Thompson chair of chemical metallurgy. The chair, which has been endowed by the International Nickel Company, honors two alumni of Columbia's School of Mines—ROBERT C. STANLEY, who was chairman of the Board and chief officer of International Nickel until his death in 1951, and JOHN F. THOMPSON, chairman of the board and chief officer since that time.

LEWIS THOMAS has been named professor and chairman of the department of medicine in the New York University College of Medicine and director of the Third Medical Division of New York City's Bellevue Hospital Center. The appointment will become effective with the retirement of WILLIAM S. TILLETT at the close of the 1957–58 academic year. At present Thomas is professor and chairman of the department of pathology, a position he has held since he jointed the N.Y.U. faculty in 1954.

ALEX G. OBLAD, oil chemist, has been elected vice president in charge of research and development activities for the M. W. Kellogg Company, New York. The company is known for the engineering, design, and construction of oil refineries and petrochemical plants and processing units and has long been a leader in petroleum refining research.

ROBERT D. COGHILL, an organic chemist who formerly was director of research for Abbott Laboratories, Chicago, Ill., has been appointed special assistant for industrial research at the Cancer Chemotherapy National Service Center, National Cancer Institute, Bethesda, Md. Within the past year industry has greatly increased its participation in the national cancer chemotherapy program sponsored by Government and nonprofit agencies. The National Cancer Institute shares expenses with industry through contracts. Coghill will assume responsibility for all of these contracts and for recommending solutions to problems arising from cooperative research involving the National Cancer Institute, industrial firms, and investigators in academic institutions.

ARTHUR KNUDSON recently returned to this country after a 2-year assignment in Indonesia, where he was visiting professor of biochemistry at the University of Indonesia under the University of California's University of Indonesia Project in Medical Education. Knudson has already gone back to Indonesia for another 2-year assignment. He will be with the University of Kentucky Project as professor of biochemistry, aiding in the agricultural and veterinary science program at the University of Indonesia in Bogor.

ALBERT E. WHITFORD, director of the Washburn Observatory at the University of Wisconsin, has been named director of the University of California's Lick Observatory, effective 1 July 1958. He succeeds C. D. SHANE, who has been director since 1945 and who will continue at Mount Hamilton in the position of astronomer. Shane is retiring from the directorship in order to devote full time to a special research program that he has carried on for a number of years in connection with Lick's new 120-inch telescope.

For 12 years Shane has devoted a large part of his time to the task of bringing the 120-inch telescope to completion. This instrument, the second largest telescope in the world, is scheduled to begin operation soon after the first of the year.

GEOFFREY F. CHEW, formerly of the University of Illinois, and KENNETH M. WATSON, formerly of the University of Wisconsin, have been appointed full professors in the department of physics at the University of California, Berkeley.

AMOS J. SHALER, professor and head of the metallurgy department at Pennsylvania State University, is the 1957 winner of the annual $2000 Metallurgy Teaching Award that is given by the American Society for Metals for the best teaching performance on the part of a young instructor or professor in this engineering curriculum.

WILLIAM J. LACY, supervisory chemist, formerly of the Engineer Research and Development Laboratories, Fort Belvoir, Va., has been appointed to the research staff of the Health Physics Division, Oak Ridge National Laboratory, which is operated by Union Carbide Nuclear Company.

HANS F. WINTERKORN, professor of civil engineering at Princeton University, recently received the Federal Republic of Germany's Cross of Merit, first class, in a ceremony at Princeton. The cross was presented by the German consul general, D. Adolph Reifferscheidt.

Reports

Minute Plaque Mutant of Type 2 Poliovirus

A mutation of polioviruses (type 1 and type 2) to resistance to neutralizing substances—most probably inhibitors—in normal bovine serums (NBS) has been previously described (*1*). Since the mutation is characterized by altered sensitivity to normal bovine serum inhibitors, it will be designated by the letter *i* (for inhibitor). It was shown that *i* mutants of both type 1 and type 2 viruses produce definitely larger plaques on plates overlayered with agar containing 10 to 20 percent inhibitory NBS than the respective wild type (i^+) viruses (*1*). Usually MEF-1 *i* mutants were readily obtained through several serial transfers of i^+ virus in tissue cultures in the presence of inhibitory NBS.

In the course of the studies, however, it was observed that in several series of serial passages of plaque-purified MEF-1 i^+ virus in HeLa cell cultures in the presence of inhibitory NBS, *i* mutants failed to appear even after more than ten passages. In these series of serial passages, virus titers of the harvested culture fluids, assayed on HeLa cell plates with noninhibitory horse serum agar overlay, decreased markedly after several passages, in spite of the fact that the cellular destruction of the cultures appeared as rapidly as was expected; the reasons for this rapid reduction in i^+ virus titers remained unexplained.

Later, however, upon closer examination of the plates that had been seeded with lower dilutions of the culture fluids, it was found quite unexpectedly that numerous very minute plaques, sometimes barely visible to the naked eyes (less than 0.5 mm in diameter), had been produced, besides the plaques of usual sizes. The virus, forming minute plaques, was purified either by plaque isolation or by the limiting-dilution technique, and it was shown to be neutralized specifically by anti-type-2 monkey serum in HeLa cell tube-neutralization tests. Accordingly it may reasonably be concluded that an MEF-1 mutant forming very minute plaques was isolated, which will be designated *m* (minute). A brief summary of the study on the *m* mutants is given in this report (*2*).

The strain of HeLa cells employed, the preparation of parental MEF-1 virus stock, and the method of detection of inhibitory NBS were described previously (*1*). The results of a typical series (E-399) of such serial passages are shown in Fig. 1. A bottle culture of HeLa cells (8×10^6 cells) with 9 ml of medium YLA (Earle, 0.5 percent lactalbumin hydrolyzate and 0.1 percent Difco yeast extract), supplemented with 20-percent inhibitory NBS-137, was inoculated with 1 ml of undiluted MEF-1 stock (10^8 pfu/ml) and examined daily for cytopathogenic action.

As soon as cellular destruction was complete, culture fluid was harvested, and 1 ml of the harvested fluid was inoculated again into a new bottle culture of HeLa cells containing 40 percent NBS-137. The harvested culture fluids were assayed for plaques on HeLa cell plates, and a marked decrease of the titers of parental MEF-1 in successive harvested culture fluids was observed in the course of several serial transfers (Fig. 1). Furthermore it was found that very minute plaques (less than 0.5 mm in diameter) appeared after three passages; approximate titers of these *m* mutants in the culture fluid were 10^7 pfu/ml (Figs. 1 and 2). Similar titers (10^7 to $10^{7.5}$ $TCID_{50}$/ml) were obtained by titrations in HeLa cell tube cultures. Plaques produced by the *m* mutant were as small on monkey kidney cell plates as on HeLa cell plates. In another experiment (E-222), the *m* mutant was also obtained through serial transfers in HeLa cell cultures with medium YLA containing 2 percent noninhibitory horse serum.

It should be emphasized that, in the majority of such serial passages in the presence of inhibitory NBS, *i* mutants were selected, as previously described (*1*). Moreover, no *m* mutants of Mahoney strain have thus far been obtained, in spite of the large number (more than 25) of series of serial passages of this virus, and in spite of the sometimes apparently identical conditions under which they were carried out. Therefore, the factor, or factors, responsible for the selection of MEF-1 *m* mutants remains thus far unknown.

It is known that differences in plaque size exist among strains of polioviruses (*3*). However, none of the several other type 2 polioviruses maintained in our laboratory produce plaques of equally small size. It seems worthy of note that *m* mutants are indistinguishable from m^+ virus in HeLa cell cultures in growth rate, maximum titer attained, and cytopathogenic effect. Dulbecco (*4*) described a *d* (delayed) mutant of poliovirus type 1 (Brunhilde). The plaques of this line are indistinguishable from those of the wild type at *p*H 7.4, but they appear 2 days later at *p*H 6.8. Similar findings were also reported by Sabin (*5*).

In the case of *m* mutants, however, plaque formation is apparently independent of the *p*H of the agar overlay employed. Besides, the plaques of *m* mutants do not increase in size in the course of several days. Slow Mahoney, forming small plaques (2.37 to 2.66 mm) on monkey kidney cell monolayers, was obtained by Dubes (*3*) as a mutant of Fast Mahoney in HeLa cell culture. The similarity of this mutant to *m* mutant remains to be demonstrated. We have assumed that a substance, or substances, in the agar overlay inhibits in one way or another the formation of plaques of usual

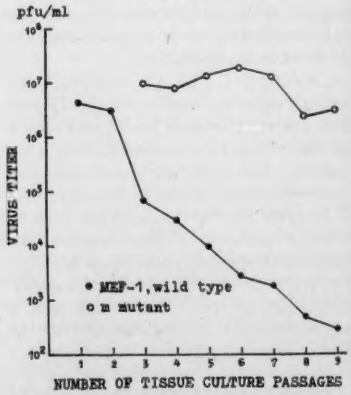

Fig. 1. Marked decrease of parental MEF-1 virus and appearance of *m* mutants in culture fluids during serial transfers of plaque-purified parental MEF-1 virus in HeLa cell cultures with medium YLA containing 20 to 40 percent inhibitory NBS-137.

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limtied to the equivalent of 1200 words; this includes the space accupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

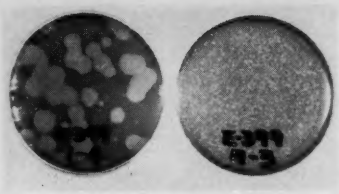

Fig. 2. Selection of MEF-1 *m* mutants in the course of the serial passage (E-399) of wild-type MEF-1 virus in HeLa cell cultures with medium YLA plus 20 to 40 percent NBS-137. Plate 1-4 was seeded with 10^{-4} dilution of first-passage fluid plaques of the MEF-1 wild-type virus. Plate 7-3 was seeded with 10^{-3} dilution of seventh-passage fluid plaques of MEF-1 *m* mutants. Both platings were made on the same lot of HeLa cell monolayers (55-mm petri dishes) with 10 percent horse serum agar overlay. The photograph was taken 5 days after the plates were seeded.

size by this particular mutant. This possibility is now being extensively studied, and the evidence thus far obtained seems to indicate clearly that *m* mutants have a unique sensitivity to the viral inhibitory activity of extract of agar overlay.

The *m* mutants have been compared with m^+ virus in virulence for mice by the intracerebral route of inoculation and have been found to be slightly less virulent than m^+ virus. The *m* mutants were stable through ten rapid serial passages in tissue cultures of both HeLa and monkey kidney cells. However it was found that a few larger plaques sometimes appeared on plates seeded with low dilutions (10^0 to 10^{-3}) of *m* mutants. Since the *m* mutants had been previously purified repeatedly by the limiting-dilution technique, it seems clear that the *m* virus gives rise to mutants of the m^+ type—that is, it reverts to wild type with respect to plaque size. Furthermore, the back mutant m^+ virus, after having been plaque-purified, was shown to have *i* character—that is, it is resistant to the inhibitory NBS used in the medium for serial transfers, and it produces large plaques on inhibitory NBS plates. Back mutations of other poliovirus mutants have also been noted by other investigators (*3*, *4*).

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23 August 1957

Concentration of Ceruloplasmin in Plasma of Schizophrenic Patients

Akerfeldt has recently reported that N,N-dimethyl-*p*-phenylenediamine (DPP) is oxidized to red products more rapidly by serum from schizophrenic patients than by serum from healthy control subjects (*1*, *2*). The oxidation of DPP is accelerated by ceruloplasmin (*1–4*), the plasma copper-protein, and inhibited by other substances in serum, including ascorbic acid (*1*, *2*). Since measurement of the oxidation of DPP by serum may possibly have diagnostic value in mental disease (*1*, *2*), and since ceruloplasmin is of prime importance in this oxidation, it is of interest to measure directly the concentration of ceruloplasmin in the serum, or plasma, of schizophrenic and healthy subjects. This report presents the results of such determinations in 20 schizophrenic and 21 control subjects.

The concentration of ceruloplasmin was measured spectrophotometrically (*3*, *5*, *6*). Blood was drawn from a fasting subject, and coagulation was prevented by the addition of 1.5 ml of 2.5-percent sodium citrate solution to each 10 ml of blood. The plasma was separated and clarified at 24,000 *g* in an International PR-2 centrifuge. After the optical density (O.D.) of the plasma had been measured at 610 mμ in a cuvette of 5-cm path length, the ceruloplasmin was decolorized by the addition of 0.1 ml of a 10-percent solution of sodium cyanide to the cuvette, which contained 2.7 ml of plasma. One hour later the optical density was again measured at 610 mμ. The difference in optical density

$$\Delta(\text{O.D.})^{5\text{ cm}}_{610\text{ m}\mu}$$

was divided by 0.0034 to obtain the ceruloplasmin concentration in milligrams per 100 milliliters (*3*). Measurement of the recovery of added ceruloplasmin to plasma has shown that this method is accurate to about ±4 percent (*6*).

All the schizophrenic patients studied were free from significant somatic disease and were hospitalized in either the New York State Psychiatric Institute or the Bronx Municipal Hospital Center. The diagnosis of schizophrenia was made by staff psychiatrists without knowledge of the results of this study. Some of the patients were undergoing insulin-coma therapy at the time blood was drawn, as shown in Table 1. The control subjects were healthy medical students, house officers, and other medical school and hospital personnel.

The results of the determinations in the 20 schizophrenic patients and the 21 control subjects are shown in Table 1. The distributions of the plasma ceruloplasmin concentrations in the two groups show a considerable overlap. There is a range of 19 to 37 mg/100 ml in the schizophrenic patients, with a mean value of 27.8 mg/100 ml, and a range of 16 to 33 mg/100 ml in the control subjects, with a mean value of 23.7 mg/100 ml. Only three of the patients have concentrations greater than the highest value shown by a control subject. Four of the 20 patients have ceruloplasmin concentrations below the mean value of the control group, and five of the 21 control subjects have values above the mean of the schizophrenic group.

These findings indicate that it would be hazardous to classify an individual into one of the two groups on the basis of his ceruloplasmin concentration. Furthermore, it is relevant to emphasize that plasma ceruloplasmin concentrations which are significantly higher than normal by the *t* test occur in such apparently unrelated clinical conditions as a variety of neurological diseases (*6*), liver disease (*6*), and pregnancy (*7*), and marked increases in the concentration of this protein have been reported in infection (*8*) and myocardial infarction (*9*). Therefore, although the slight difference in the mean value of plasma ceruloplasmin in the schizophrenic and healthy groups, 27.8 and 23.7 mg/100 ml, respectively, is statistically significant (*10*), we be-

Table 1. Concentration of ceruloplasmin in the plasma of 20 schizophrenic patients and 21 control subjects.

Schizophrenic patients		Control subjects	
Sex and age	Plasma ceruloplasmin (mg/100 ml)	Sex and age	Plasma ceruloplasmin (mg/100 ml)
F, 19	25	M, 33	33
M, 25	27*	F, 22	25
M, 42	34*	M, 34	31
F, 42	28*	M, 32	27
M, 34	27	F, 40	23
M, 19	19*	F, 22	29
M, 23	21	M, 32	16
M, 22	24*	F, 32	18
M, 38	31*	F, 22	24
M, 18	36*	F, 27	20
F, 30	30*	M, 28	29
M, 19	22	M, 35	25
M, 29	30*	M, 23	17
F, 41	29*	M, 22	32
M, 22	28	M, 25	18
F, 41	30	M, 24	25
F, 27	30	M, 23	23
F, 56	37	M, 22	24
F, 27	29	M, 27	16
M, 15	20	M, 23	26
		M, 25	16
Mean	27.8	Mean	23.7

* These patients were in insulin coma when blood was drawn.

1 NOVEMBER 1957

lieve that our results indicate that measurement of ceruloplasmin concentration in an individual is not useful in determining whether or not that individual is schizophrenic.

Akerfeldt concluded from his study that the difference between sera from schizophrenic and normal subjects "in their capacities to oxidize DPP is dependent mainly on the fact that the ceruloplasmin activity is higher and the ascorbic acid concentration lower" in the sera from schizophrenic patients than they are in sera from normal subjects (*1*). Our results indicate that the concentration of plasma ceruloplasmin is not a reliable criterion for distinguishing schizophrenic from healthy individuals. It appears, therefore, that if differences in the capacity to oxidize DPP can be consistently demonstrated between sera from schizophrenic and healthy individuals, these differences cannot be ascribed merely to variations in ceruloplasmin concentration (*11*).

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10. The value of *t*, calculated from the results in Table 1, is 2.58, indicating that differences of means as large or larger than those found here would not occur more than 1 to 2 percent of the time, if caused by chance alone.
11. This work was supported in part by grants (A-572 and A-1059) from the National Institute of Arthritis and Metabolic Diseases, U.S. Public Health Service, and by a grant [NONR-1765(00)] from the Office of Naval Research. We are indebted to R. M. Simon for his assistance in the study of the schizophrenic patients.

5 August 1957

Development of a Strain of Ehrlich Ascites Tumor Cells Resistant to N-Methylformamide

Investigations of the genetic and nongenetic variability among homogeneous populations of mammalian cells have been hampered by the tendency of most mammalian cells to grow in aggregates *in vitro* as well as *in vivo*. This tendency, as well as the difficulty of obtaining variants subject to selective techniques, has to some extent discouraged the application of methods employed in microbial genetics to problems related to mammalian cell variability. As a preliminary attempt to investigate mutation and recombination among mammalian somatic cells, the applicability of selection for drug-resistant variants among populations of Ehrlich ascites tumor cells was explored. The relatively unaggregated clonal growth characteristics of Ehrlich ascites cells suspended in the mouse peritoneum (*1*) seemed to offer an opportunity for obtaining populations of homogeneous cells without the application of tissue culture techniques.

This report (*2*) is primarily concerned with the development of a population of Ehrlich ascites tumor cells resistant to N-methylformamide. The phenotype of N-methylformamide resistant cells with respect to growth rate and the survival of infected mice fed N-methylformamide is described.

A hypotetraploid Ehrlich ascites tumor originally obtained from T. Hauschka was used in this study. The tumor was maintained by injecting intraperitoneally 0.1 ml of ascitic fluid (approximately 1×10^7 cells) from a 7-day donor tumor into Swiss-Webster mice of either sex weighing between 18 and 20 g. N-Methylformamide was mixed in Purina Laboratory Chow meal at a concentration of 0.1 percent, and the mice were allowed to feed *ad libitum* from the day of inoculation until death. This concentration of the drug was optimal for tumor inhibition without toxic side effects (*3*). Determinations of the total cell populations were made by a method similar to that used by Klein and Revesz (*1*) and Lucké and Berwick (*4*).

A substantial increase in the mean survival time of mice infected with Ehrlich ascites tumor results from including N-methylformamide in the diet. The mean survival time of 237 infected mice that were fed the drug was 25.2 ± 2.7 (standard deviation) days, as compared with 13.1 ± 1.2 days for 322 mice in the absence of therapy.

A population of cells resistant to N-methylformamide was obtained by serial transfer of Ehrlich ascites tumor cells in mice fed N-methylformamide. As indicated in Table 1, a substantial shortening of the mean survival time of infected mice on N-methylformamide therapy occurred after the third serial transfer of tumor cells. The mean survival time after subsequent transfers was essentially the same for mice on therapy as for mice on the control diet and has remained between 14 and 19 days for over 80 transfer generations.

The shortened survival time was ac-

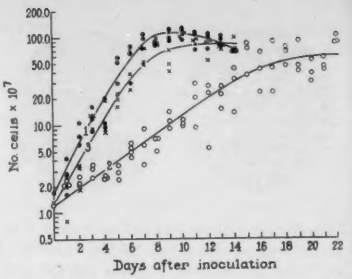

Fig. 1. Number of Ehrlich ascites tumor cells in the mouse peritoneum as a function of time. Curve 1 (●), N-methylformamide sensitive cells; no therapy; curve 2 (○), sensitive cells on N-methylformamide therapy; curve 3 (×), N-methylformamide resistant cells obtained after the 37th transfer generation in the presence of N-methylformamide on N-methylformamide therapy. Each point represents the total cell population of a single mouse peritoneum.

Table 1. Onset and maintenance of resistance of Ehrlich ascites cells to N-methylformamide (NMF). For the first 28 serial transfer generations cells were obtained from mice 14 days after inoculation. Subsequent to the 28th transfer generation, cells were obtained after 7 days' growth. While the data are too numerous to be presented *in toto*, the mean survival time of all mice on NMF from the third to the 80th transfer generation was 15.6 ± 1.7 days (718 animals). Although groups of animals fed an NMF-free diet were not employed regularly before the 11th transfer generation, the mean survival time of all animals so treated was 14.9 ± 2.2 days (615 animals).

Transfer generation	Drug	No. of mice	Mean survival time (days) ± S. D.*
1	NMF	8	24.3 ± 1.3
1		10	11.1 ± 1.9
2	NMF	7	23.1 ± 2.4
2		8	15.3 ± 2.1
3	NMF	7	16.4 ± 2.0
4	NMF	7	14.7 ± 2.9
5	NMF	6	14.5 ± 5.6
7	NMF	8	17.0 ± 5.4
9	NMF	9	14.6 ± 3.9
11	NMF	9	16.0 ± 2.8
11		7	16.6 ± 3.2
13	NMF	7	15.1 ± 3.1
13		4	14.5 ± 2.2
15	NMF	8	16.1 ± 3.6
15		10	14.7 ± 2.2
20	NMF	9	14.8 ± 3.6
20		6	14.3 ± 3.2
30	NMF	9	15.8 ± 2.5
30		9	16.5 ± 1.6
50	NMF	13	14.4 ± 3.5
50		9	14.4 ± 3.6
80	NMF	10	12.4 ± 2.1
80		9	9.9 ± 2.0

* S.D. = standard deviation.

companied by a very obvious visible increase in the rate of tumor growth. Very little ascitic fluid could be obtained from mice on N-methylformamide therapy when the mice were infected with sensitive tumor cells before 14 days of growth. Under the same circumstances, infection with resistant cells resulted in extremely large yields of ascitic fluid by the seventh day after inoculation. This difference in tumor growth rate was examined by direct count of ascitic cells present as a function of time. As shown in Fig. 1, the generation times of sensitive cells in the absence of therapy and of resistant cells in mice fed N-methylformamide were 24 and 26 hours, respectively. The generation time of sensitive cells in the treated host was approximately 66 hours. The growth rate of resistant cells in the absence of therapy is indistinguishable from that of sensitive cells under the same circumstances.

To test whether resistance to N-methylformamide was due to some adaptive mechanism depending on the presence of N-methylformamide for its maintenance, mice fed an N-methylformamide-free diet were infected with resistant tumor cells. At 7-day intervals mice were sacrificed, and the cells obtained were transferred to another group of mice fed the N-methylformamide-free diet. At each transfer generation a group of inoculated mice was fed N-methylformamide. The data obtained for 50 serial transfer generations were quite homogeneous and quite similar to those already presented in Table 1 (transfer generations 11 to 80). This indicates that resistance is maintained in the absence of therapy and that the resistant cell population displays a degree of stability indicative of a genetic alteration.

It seems probable, in view of the above, that N-methylformamide resistance arose as a consequence of mutation and selection in a manner analogous to the appearance of resistance in bacterial populations suggested by Law (*5*). Direct tests of this notion are not easily performed with this material. However, it can be indirectly examined by determining whether the appearance of resistance during the third transfer generation in the presence of the drug (Table 1) was consistent with a reasonable mutation rate (about 10^{-6} or less). As was pointed out previously, the generation time of the sensitive cells in the presence of N-methylformamide is 66 hours, while that of the resistant cells is 26 hours. Since enough time is available between transfers (14 days) to allow more than five sensitive cell generations per transfer, one resistant cell per 10^5 to 10^6 sensitive cells in the original inoculum would have time to become the predominant member of the total cell population within three tumor transfer generations. Thus the observed rapidity of the onset of resistance is not inconsistent with a mutation rate of about 10^{-6}.

Preliminary experiments using artificial mixtures of 10^7 sensitive cells and 10, 10^2, and 10^3 resistant cells have yielded resistant cell populations within the intervals expected on the basis of the generation times of the two cell types in the presence of the drug.

A recent report by Potter and Law (*6*) of the development of resistance to azaserine by an ascitic form of a plasma cell neoplasm and its stability in the absence of the drug suggests the general efficacy of the selection of drug-resistant ascitic cells *in vivo*. Cell lines resistant to N-methylformamide and azaserine would seem eminently suitable for biochemical as well as for more refined genetic analysis. However, these analyses would probably best be done in tissue culture under more defined conditions than those afforded by the mouse peritoneum.

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29 August 1957

Discovery of Cholesterol in Some Red Algae

There have been some reports on the isolation of algal sterols, including fucosterol (*1*), sitosterols (*2*), chalinasterol (*3*), and sargasterol (*4*), but there has been no report on the isolation of cholesterol from the vegetable kingdom. This report (*5*) describes the discovery of cholesterol in some red sea weeds (Rhodophyceae).

Dry powder of *Rhodoglossum pulcherum* (Kützing) Setchell et Gardner (*6*) was extracted three times with boiling benzene and with stirring, and the resultant dark brown oil (1.1 percent) was saponified with 4-percent methanolic alkali. Subsequent extraction with benzene afforded an unsaponifiable matter (12 to 13 percent from crude oil). Standing a methanolic solution of it in a refrigerator overnight yielded yellow-colored crystals (55 percent from unsaponifiable matter). A few recrystallizations from methanol gave a sample of melting point 142° to 145°C (*7*), which was precipitated with digitonin and which was positive with Liebermann-Burchard's color test.

Purification of the sterol (mp 142° to 145°C) twice through its dibromoacetate, which is precipitable in a solution of dry ether and glacial acetic acid, gave a pure sample of mp 147° to 148°C; $[\alpha]_D$ −40.0 (*8*). Perbenzoic acid titration, bromination, and catalytic hydrogenation of the steryl acetate indicated that the sterol possesses just one double bond. The following derivatives were made from the pure sterol: (i) Acetate, mp 114° to 115.5°C; $[\alpha]_D$ −44. (ii) Benzoate, mp 144° to 145.5°C; $[\alpha]_D$ −14. (iii) Stenone, mp 84° to 86°C; $[\alpha]_D$ +88; $\lambda_{max.}^{EtOH}$ 241 mμ (ε, 17,800, calculated as cholestenone). (iv) Stanol, mp 142° to 143°C; $[\alpha]_D$ +23.5. (v) Dibromosterylacetate, mp 113° to 114°C; $[\alpha]_D$ −47.8. (vi) Dibromide, mp 112° to 114°C; $[\alpha]_D$ −44.3.

All these derivatives of the sterol were identified with the corresponding derivatives of authentic cholesterol by mixed melting points and infrared spectra. Furthermore, the result of x-ray diffraction analysis of the algal stenone was the same in all respects as that of authentic cholestenone within an error of 1 percent, including experimental errors. We are therefore convinced that the sterol is cholesterol.

In addition, we also isolated cholesterol from easily soluble fractions of the sterols obtained from some other red algae, all of which (*9*) belong to the family Gelidiceae: *Gelidium amansii* (Iam), *Gelidium subcostatum* (Okam.), *Pterocladia tenuis* (Okam.), *Gelidium japonicum* (Okam.), and *Acanthopeltis japonica* (Okam.).

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5. A final report is in preparation. We thank Y. Yamada, T. Uchida, Y. Nakamura, and M. Yamada of Hokkaido University for their kind advice, which helped us in collecting and identifying the algae. We are also indebted to S. Sudo of the Tokai Fishery Research Institute and to the members of the Ito Fishery Research Section in Shizuoka Prefecture for their kind help in collecting the algae.

6. This alga was collected at Akkeshi in Hokkaido in June and was carefully selected to avoid contamination with any traces from animal sources.
7. All melting points listed are uncorrected.
8. All optical rotations were measured in chloroform at 25°C.
9. The algae were collected at Shirahama in Shizuoka Prefecture.

15 July 1957

Prenatal Protection of Mice by Yeast Antibiotic (Malucidin)

We prepared a complex protein with antibiotic properties from brewer's and baker's yeasts. This material, when injected into animals in doses of 1 to 10 mg/kg of body weight, protected them against infections caused by a number of organisms, including several species of Gram-positive and Gram-negative bacteria, fungi (including *Candida albicans*), and *Shigella* endotoxin (*1*). In many respects this material is different from other antibiotics; it has a very wide spectrum of activity and a long-lasting effect. Mice injected with larger doses of this new agent were refractory to inoculation with *Proteus* OX19 for at least 1 mo. This observation stimulated our interest in investigating the effect on their offspring of treatment of pregnant mice with Malucidin.

The mice received injections of Malucidin in the later stage of pregnancy and 2 to 3 days later gave birth to litters. Injections of Malucidin were given intravenously or intraperitoneally; since there was no difference in the results after injection of Malucidin by either route, the data were combined (Table 1). Young mice were tested for resistance to *Proteus* infection when they reached the age of 2 to 3 weeks, in which stage they continued to be suckling. Results are summarized in Table 1.

Table 1. Protection of mice by prenatal injection of Malucidin. Numerators indicate the number of survivors; denominators indicate the number of mice used.

Group No. and treatment of mother	No. of Proteus organisms injected into suckling mice			
	250 M	750 M	1.5 B	3 B
Experiment with mice 3 wk old (av. body weight, 7 g)				
1. Control—no treatment	3/4	0/7*	0/2	0/2
2. Injected with 5 mg of Malucidin on 2 consecutive days	2/2	9/12*	2/4	0/6
Experiment with mice 2 wk old (av. body weight, 5 g)				
3. Control—no treatment	0/5	0/6		
4. Injected once with 10 mg of Malucidin	3/4	0/6		
5. Injected twice with 10 mg of Malucidin 24 and 48 hr after birth of offspring	0/5	0/6		

* The difference between these two groups was statistically significant: $P < 0.01$.

As can be seen from the table: (i) pregnant females treated with Malucidin produced progeny more resistant to *Proteus* infection than those of normal, untreated mice; and (ii) as group 5 indicates, the resistance was not transmitted with the milk, since the offspring of mice treated with Malucidin after delivery were not more resistant than normal, untreated mice.

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28 June 1957

Volcanic Activity and Alaskan Spruce Growth in A.D. 1783

In the absence of historical accounts, tree-ring chronologies have provided considerable data for reconstructing climate of the past. This report is an attempt to explore further the association between a specific series of climatic phenomena, volcanic eruptions, and anomalies in Alaskan tree-ring patterns for the year A.D. 1783. The effects of major volcanic activity upon world climate were amply dramatized by the significant drop in world temperatures following the eruption of Tomboro in 1815, of Krakatoa in 1883, and of Katmai in 1913 (*1*). It now seems possible that, under certain conditions, previously unrecorded volcanic eruptions can be detected by their effect on the annual ring records of white spruce [*Picea glauca* (Moench.)] in western Alaska.

When J. L. Giddings began his northern Alaskan tree-ring studies, he noted that the final growth cells for the year A.D. 1783 were obscure, particularly in ring records of spruce growing at tree line and at the biological limit of the species. At the time the ring sealed off for that year, a distinctive layer of thin, faintly visible cells was added, rather than the customary dark late cells; this layer has been designated "faint latewood" (*2*). The 1783 faint latewood is common to many, but not to all, northern Alaskan white spruce which have been sampled and which are of sufficient age to contain it. The unique ring occurs sporadically in tree-line spruce of the Copper and Kuskokwim rivers and is common in the Yukon River spruce (*3*).

On the basis of recent inquiries it appears probable that the unique characteristics of the 1783 ring bear a direct relationship to certain widespread natural phenomena that occurred during the summer of 1783 in Europe, Japan, and the United States. In the eastern United States, at least, this was a year without a summer. Benjamin Franklin (*4*) commented upon the climate for this particular year and noted:

"During several of the summer months of the year 1783, when the effects of the sun's rays to heat the earth in these northern regions should have been the greatest, there existed a constant fog over all Europe, and great part of North America. This fog was of a permanent nature; it was dry, and the rays of the sun seemed to have little effect toward dissipating it, as they easily do a moist fog, arising from water. They were indeed rendered so faint in passing through it that, when collected in the focus of a burning-glass, they would scarce kindle brown paper. Of course, their summer effect in heating the earth was exceedingly diminished.

"Hence the surface was early frozen.

"Hence the first snows remained on it unmelted, and received continual additions.

"Hence perhaps the winter of 1783–4 was more severe than any that happened for many years."

Franklin further stated that smoke from a volcanic eruption in Iceland might have been carried by winds to various parts of the world, which would explain the abnormally cold summer. The Skaptar Jokull eruption in Iceland was the one to which he referred, and it was most active on 8 and 18 June of 1783. Symons (*5*) noted that a "dry fog" appeared over all of Europe on 17 June 1783 and that it was world-wide in its distribution.

In a recent study of summer temperature and Scandinavian tree growth, Schove (*6*) remarks that Finland had a bad harvest during 1783, while central Europe had a great deal of heat and excessive south and southeasterly winds. He states further that the narrowness of the tree-rings in northern Europe for that year may have been due to the dust-haze that followed the volcanic eruptions, and he also comments upon the peculiar nature of this ring in Alaska.

In addition to the major volcanic activity in Iceland, there was also the eruption of Asama in Japan, on 4 Aug. 1783, which has been termed "the most frightful eruption on record" (*5*, *7*).

Spruce increment borings were taken recently by the writer in western Alaska during the growing season, and these may serve as a gross index of the period of growth in western Alaskan spruce.

Indications are that radial growth begins as early as the middle of June and extends as late as the latter part of August, with most growth in the month from 5 July to 5 August. If the spruce in western Alaska grew at the same time of year in 1783 as they grow at present, they might have been adding cells at the time of the major Iceland eruptions but would have been approaching the latter stages of growth during the great Japanese eruption. To judge from a comparison between the ring size for 1783 and the size of adjacent rings, it seems likely that the faint latewood was added toward the end of the growing season. An abrupt drop in temperature in Alaska, such as would seemingly accompany these eruptions (*1*), could account for the sudden cessation of growth in the middle-late growing season and for the thin latewood layer.

It would appear to be more than mere coincidence that two great volcanic eruptions, low summer temperatures in North America, and the unique faint latewood all occurred in the summer of 1783; these phenomena could hardly have occurred simultaneously without being significantly linked.

One important fact that emerges from the association of the 1783 ring and great volcanic activity for this year is that, if the above assumptions are correct, the precise year-to-year accuracy of the tree-ring chronology for western Alaska, at least as far back as 1783, is verified.

Further inquiry into the relationship between volcanic activity and tree growth was undertaken in the summer of 1954 in the Katmai National Monument area of the Alaska Peninsula under the sponsorship of the Katmai Project of the National Park Service. An analysis of a limited sample of ten increment borings of white spruce indicated that similar ring anomalies were produced during summers of historically documented great volcanic activity in this area.

It seems probable that intensive studies of tree-ring records in spruce of the Alaska Peninsula region—an area in which there are eruptions recorded during the summer growing season—would afford enough control data to make apparent certain earlier but previously unrecorded eruptions in the Aleutian arc.

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2 August 1957

Regeneration of Adult Mammalian Spinal Cord

Recent research by Windle shows that axons can regenerate across gaps in completely transected spinal cords of animals treated with Piromen (*1*). This observation stimulated a modification of the peripheral nerve regeneration technique (*2*) that was evolved in our laboratory to approach the problem of paraplegia. In brief, the method consists of encasing the proximal and distal ends of the severed portion of the feline sciatic nerve or the spinal cord with a nylon tube (*3*) impregnated with cellulose acetate (Millipore) (*4*). A sling stitch is used between the severed ends to maintain them within the tube.

The H.A. formulation of Millipore has 80% of its volume occupied by 0.45-μ pores. This physical characteristic provides the proliferating neural and supporting elements adequate nutrition by diffusion of body fluids, while protecting the regenerating nerve from invasion by mesenchymal cells in the tissue bed. The plastic is extremely inert in tissues and rapidly becomes surrounded by a pseudosynovium. No foreign-body response is found (*5*).

Complete spinal transection at the third thoracic level in a series of adult cats produced gaps of 4 mm as the segments of the cord retracted. Thirty days after transection, the proximal and distal ends of the spinal cord were united by a firm bridge of tissue (Fig. 1, top). Microscopic examination of histological sections of material from cords 30 days after transection showed an orderly, linear regeneration of axons in the gap without overproliferation of glial tissue or of the pia-arachnoid complex (Fig. 1, bottom).

It is tentatively postulated that peripheral and central neural elements are induced to regenerate in an orderly fashion as the result of the scaffolding provided by the Millipore tube. In addition, the sling stitch may orient the fibrin and other proteins into a pattern favorable for linear regeneration. Experience with peripheral nerves shows that the technique requires a single sling stitch, rather than the multiple filaments advocated by Alexander, Matson, and Weiss (*6*).

Return of function has been verified

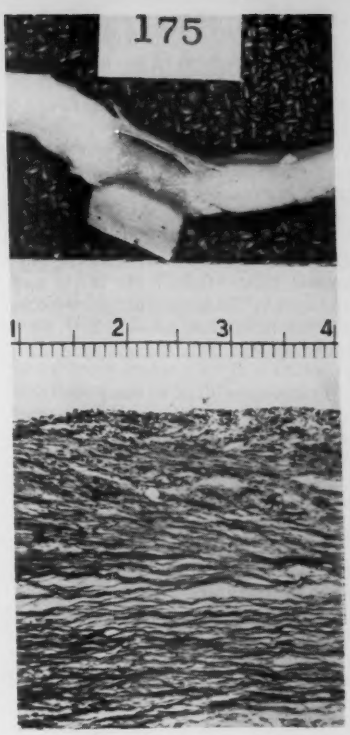

Fig. 1. (Top) Feline spinal cord 30 days after transection, Millipore tube opened (Formalin-fixed); (bottom) axons at the level of transection, 30 days, Bodian (× 200).

70 days after the creation of a 2.5-cm gap in peripheral nerves. However, more time is required before an evaluation of functional return in the transected spinal cords can be made (*7*).

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16 August 1957

Book Reviews

Economic Development. Theory, History, Policy. Gerald M. Meier and Robert E. Baldwin. Wiley, New York; Chapman & Hall, London. 1957. xix + 588 pp.

This volume is one of many evidences of the resurgence of interest among economists in economic development. Since Adam Smith set forth the philosophy of *laissez faire* as a framework for a growing wealth of nations, few economists have addressed themselves directly to the subject. Smith contributed an economic philosophy that blended well, in its time, with emerging technology, a growing spirit of scientific inquiry, the rise of democratic institutions and individual liberty, and an emerging confidence in economic progress. The result was an unexampled economic advance in Western countries. This notable achievement, one might expect, would be a subject of intense scientific inquiry. Instead, economists have taken it largely for granted and have barely nibbled at the edges of the most dramatic historical event of their times.

In consequence, a world-wide interest in economic development, after 1945, found itself largely without an understanding of the process by which economic advances are achieved. It was equally without criteria for judging action and policy proposals for economic improvement. Into this void have flowed, in recent years, countless special studies and a few comprehensive reviews of economic development today.

Of these latter studies, the most notable are *Approaches to Economic Development* by Norman S. Buchanan and Howard S. Ellis (Twentieth Century Fund, 1955), *The Theory of Economic Growth* by W. Arthur Lewis (Irwin, 1955), *The Economics of Under-Developed Countries* by P. T. Bauer and B. S. Yamey (Nisbet, 1957), and the volume here under review.

As an introduction to economic thinking about the problems of economic development, the present volume is the most comprehensive yet to appear. It is not so much a study of the subject as a review of the literature on the subject. It begins with the *laissez faire* philosophy of Adam Smith, reviews the ideas of classical economists, of Marx, of neoclassical analysis, and of the more modern concepts of Schumpeter, Keynes, and post-Keynesian economists. There follows a very sketchy outline of economic development in the last 200 years, mainly as seen by economic historians. Next, the problems of economic development in poor countries are considered, with special attention to the obstacles to development, the requirements for development, and the policy issues that underlie these efforts. Finally, consideration is given to the further development of rich countries. Here the objectives, trends, requirements, and prospects are considered.

Throughout the volume the authors rely heavily on the views presented in other studies. To acknowledge this fact is not to deprecate the achievements of Meier and Baldwin. They have made a monumental attempt to bring together the pertinent contributions in order to show the essential logic of economic development and to present a framework in which to consider problems of economic growth. The study is essentially a textbook in concept and approach. It is a good introduction for instructional use and will doubtless be widely used.

Those engaged in the labor of economic development will find the volume less satisfactory. For them the book inadequately portrays the economists' current understanding of the process of economic development. It largely ignores noneconomic influences. It offers little toward the establishment of priorities and criteria for the choice of policies. In brief, the volume escorts the reader through the library, but it does not lead him, with a sure hand, through the maze of confusion in the outside world of economic affairs.

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Experimental Designs. William G. Cochran and Gertrude M. Cox. Wiley, New York; Chapman & Hall, London, ed. 2, 1957. xiv + 616 pp. $10.25.

The second edition of *Experimental Designs*, by William G. Cochran and Gertrude M. Cox, consists of 611 numbered pages and five unnumbered pages of tables, compared with 454 pages in the first edition. This increase of approximately 36 percent has not allowed the authors enough space to list all designs that are now known and commonly used but has enabled them to present, in part at least, the important developments in experimental design that have appeared since the first edition was published (1950).

Since the first edition was so well received, the general framework has been retained. Chapters 1, 7, 8, 9, 12, 14, and 15 have been carried over to the second edition without major change in content or numbering. The remaining eight chapters of the first edition appear with additions, replacements, or omissions. Thus, in chapter 2, section 2.21a (not 2.22a, as stated in the preface to the second edition) has been added, and a section 2.23a, "Sequential experimentation," replaces section 2.23, "The case where additional assurance is desired." The lowercase *a* attached to the section numbers is used throughout to indicate new sections.

In the first edition, fractional replication of factorial experiments was discussed briefly in section 6.25 of chapter 6. The authors have omitted this section in the new edition and have added chapter 6A in order to give a complete account of fractional replication—a procedure which has proved to be very useful in exploratory research. Another development in the field of factorial experiments developed especially for inductional research and development is presented in chapter 8A.

The addition of tables of t and F seems worth while, but one wonders why they were omitted in the first edition and why a table of χ^2 was not included in the second edition.

One does not have to be a seer to predict that the second edition of *Experimental Designs* will be well received.

A. E. BRANDT
U.S. Atomic Energy Commission, New York

Russian-English Atomic Dictionary. Eugene A. Carpovich. Technical Dictionaries, Box 144, New York 31. 317 pp. $12.

This dictionary, intended for English-speaking users, contains more than 23,000 Russian entries covering nuclear science and technology and related areas of other sciences. Also included are selected general technical terms, proper names, and abbreviations. All entries are arranged in a single alphabet, and the typography permits easy scanning. Coverage in general seems good, but there is some evidence of padding (for example, more than 50 entries for nouns modified by the adjective *radioactive*). Definitions and equivalents are usually precise and terse, but occasional lists of English syno-

nyms appear (such as "underground, subterranean, subterraneous, below-ground, subsurface . . ."). Typographical errors and misspellings are infrequent and usually unimportant. The book fills a definite need.

THOMAS E. HUGHES
Library of Congress

The United Kingdom Contribution to the International Geophysical Year, 1957–58. The Royal Society, London, 1957. 72 pp. Illus. 10s.

In this official publication a number of interesting and informative facts about the United Kingdom program for the International Geophysical Year are outlined.

Following a brief historical introduction, the participating individuals and institutions in the United Kingdom and the Colonies are listed, and their varied functions are described. The official IGY Calendar, indicating the Regular World Days and the World Meteorological Intervals during the IGY, is reproduced. A comprehensive list of the stations participating directly or indirectly is given, and the distribution of these stations is mapped.

A useful list of the membership of the principal subcommittees of the British National Committee is included.

The Effect of Exposure to the Atomic Bombs on Pregnancy Termination in Hiroshima and Nagasaki. Publication No. 461. J. V. Neel and W. J. Schull. Atomic Bomb Casualty Commission, National Academy of Sciences–National Research Council, Washington, D.C., 1956. 241 pp. Illus. $2.

A little over 12 years have passed since the atomic bombs were dropped on Hiroshima and Nagasaki, and many reports have been issued on various aspects of their effects. Some, like the present one, have attempted to elicit basic information which could help man cope with the new technology rather than help him find better ways to destroy himself. As Americans we can take some consolation from the existence of the former reports and from the knowledge that they have been supported by our Government.

In the authors' words, "The present monograph is designed as a detailed report on certain efforts made during the period 1946–1955 to provide answers to the following two questions: 1. Can there be observed, during the first year of life, any differences between the children born to parents, one or both of whom were exposed to the effects of atomic bombing of Hiroshima and Nagasaki, and the children born to suitable control parents, and 2. If differences do exist, how are these to be interpreted?"

The study was undertaken on the recommendation of an *ad hoc* genetics conference convened by the National Research Council in the summer of 1947. This conference, after recommending that the study be undertaken, made the following statement: "Although there is every reason to infer that genetic effects can be produced and have been produced in man by atomic radiation, nevertheless the conference wishes to make it clear that it cannot guarantee significant results from this or any other study on the Japanese material. In contrast to laboratory data, this material is too much influenced by extraneous variables and too little adapted to disclosing genetic effects. In spite of these facts, the conference feels that this unique possibility for demonstrating genetic effects caused by atomic radiation should not be lost."

The research was actively initiated in March 1948 and was ended in February 1954. The first children to come under the scrutiny of the program were conceived in October 1947, 2 years after the bombs were dropped.

The members of the *ad hoc* committee were not exaggerating when they emphasized the importance of extraneous variables in this population. The reader cannot help but be greatly impressed by the diligence and ingenuity of the authors and their collaborators in overcoming the many complications which confronted them. Nor can the reader fail to be impressed by the generous cooperation of the Japanese victims of the bomb—midwives, physicians, clerks, and many others in the cities of Hiroshima and Nagasaki.

The first six chapters are a detailed and lucid account of the background, the plan, a comparison of Hiroshima and Nagasaki, the criteria of radiation employed in the study, the comparability of irradiation subclasses, and the statistical methods employed in the study.

The amount of radiation received by exposed individuals was estimated as a function of the distance of the individual from the hypocenter of the bomb and of the amount of shielding the individual reported he had had. Each individual was placed in one of five classes: (i) those not exposed to the bomb; (ii), (iii), and (iv), those who were successively closer to the hypocenter of the bomb and who had progressively decreasing amounts of shielding; (v), those who showed epilation, petechiae, or oropharyngeal lesions, singly or in combination, within 3 months of the bombing, regardless of their position or amount of shielding relative to the hypocenter, provided the distance was less than 3000 meters. The estimates of the amount of radiation received by individuals in categories i through v, respectively, are as follows: essentially none; 5 to 10 roentgens equivalent physical (rep); 50 to 100 rep; 100 to 150 rep; 200 to 300 rep. The authors emphasize that these are, at best, very rough estimates.

Six indicators of genetic damage were used: the sex ratio, birth weights, measurements of bodily development, and the frequencies of stillbirths, neonatal deaths, and gross malformations. The data were sorted to obtain nonoverlapping indicators. Thus, a stillborn child with a malformation was considered only as a child with a malformation but not in the stillbirth group; similarly, a live-born child with a malformation was considered only in the malformation group but was not represented in the analysis of the frequency of stillborn versus live-born children. A chapter is devoted to a detailed presentation of the analysis of each of these indicators. These chapters are followed by others devoted to the analysis of the data concerning death during the 9-month period following delivery, the analysis of the anthropometric data, the autopsy findings, and chapters entitled "Recapitulation" and "Permissible inferences," respectively.

Despite the careful analysis of 71,280 pregnancies, the authors were unable to detect a significant effect of radiation on these pregnancies. It should be noted, however, that half of these pregnancies occurred in families in which both parents were in radiation category i, and that 67,599 of these pregnancies occurred in families in which one or both parents were in radiation categories i, ii, or iii. Only 3681 pregnancies occurred in families in which one or both parents were in categories iv or v, those that had received the most irradiation.

The authors point out that the problems posed in employing survey data in an analytical fashion are legion, and "as a consequence, it is doubtful whether, given a body of survey data, any two competent statisticians would evolve essentially the same approach." They have chosen the conservative approach of testing the null hypothesis—that there was no effect of the radiation on the outcome of the pregnancies. It has been suggested that more meaningful information might have been gleaned from the data had the authors chosen to use regression analysis, estimating the irradiation received by each individual and treating him as an individual rather than as one of a group. Fortunately, all the information collected has been coded on I.B.M. cards and will be made available to the investigator who wishes to explore other lines of analysis, provided he meets the costs of duplicating the cards and all shipping charges.

The last chapter of the monograph, "Permissible inferences," is discursive and, to me, seems the weakest portion of the report. It contains a lengthy and seemingly unnecessary and sometimes

hypercritical analysis of H. J. Muller's writings on the effects of radiation on man. It also contains the curious conclusion that, because there are uncertainties in the assumptions made in certain calculations and because "persons not thoroughly indoctrinated in genetics and unfamiliar with the shaky basis of the primary assumptions" may overlook these uncertainties and may as a consequence attribute greater exactitude to quantitative calculations than the investigators mean to imply, no such calculations should be made. It would seem that educated estimates, even though they may be quite inaccurate, are better than no estimates, and that this is especially true at present, when standards of permissible dosages of the radiation are being set.

While I may disagree with some statements made in the final chapter, I heartily concur with the authors' efforts "to emphasize the present inadequacies in our knowledge of the operation of natural selection on human populations, inadequacies which permit widely different viewpoints" and with their statement that, "on the basis of extensive plant and animal work, it seems reasonable to conclude that all levels of the radiation of human populations will result in mutation production. There is a high probability (but not certainty) that under the conditions of western culture such mutation will act to the detriment of the populations concerned." I might add that there is certainty that such mutations will be detrimental, in the overwhelming majority of cases, to those who are homozygous for them.

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Books Reviewed in The Scientific Monthly, November

The Zeppelin in the Atomic Age, E. J. Kirschner (Univ. of Illinois Press). Reviewed by A. J. Fairbanks.

A Naturalist in Palestine, V. Howells (Philosophical Library). Reviewed by W. Beebe.

In-Service Education for Teachers, Supervisors, and Administrators, N. B. Henry, Ed. (Univ. of Chicago Press). Reviewed by H. E. Wise.

Aspects of River Pollution, L. Klein (Academic Press; Butterworth's). Reviewed by J. Durham.

Introduction to Operations Research, C. W. Churchman, R. L. Ackoff, and E. L. Arnoff (Wiley; Chapman and Hall). Reviewed by S. E. Gluck.

Lecture Notes on the Use of the Microscope, R. Barer (Thomas). Reviewed by O. W. Richards.

The Copernican Revolution, T. S. Kuhn (Harvard Univ. Press). Reviewed by H. N. Swenson.

Inventors and Inventions, C. D. Tuska (McGraw-Hill). Reviewed by A. M. Palmer.

Patent Notes for Engineers, C. D. Tuska (McGraw-Hill). Reviewed by A. M. Palmer.

The Mathematics of Physics and Chemistry, H. Margenau and G. M. Murphy (Van Nostrand). Reviewed by S. S. Ballard.

Coal Science, D. W. van Krevelen and J. Schuyler (Elsevier). Reviewed by H. C. Howard.

New Books

Dry-Battery Receivers with Miniature Valves. E. Rodenhuis. Philips Technical Library, Eindhoven, Netherlands, 1957. 240 pp. $4.95.

Effect of Radiation on Human Heredity. Report of a study group convened by WHO together with papers presented by various members of the group. World Health Organization, Geneva, 1957 (order from Columbia University Press, New York). 168 pp. $4.

Quantitative Pharmaceutical Chemistry. Glenn L. Jenkins, John E. Christian, George P. Hager. McGraw Hill, New York, ed. 5, 1957. 570 pp. $8.50.

Introduction to Riemann Surfaces. George Springer. Addison-Wesley, Reading, Mass., 1957. 315 pp. $9.50.

Rocket Power and Space Flight. G. Harry Stine. Holt, New York, 1957. 182 pp. $3.75.

Nuclear Power Reactors. James K. Pickard, Ed. Van Nostrand, Princeton, N.J., 1957. 350 pp. $8.50.

Comparative Physiology of the Nervous Control of Muscular Contraction. Graham Hoyle. Cambridge University Press, London, 1957. 155 pp. $3.

Les Caractères des Organismes Vivants. Maurice Rose. Presses Universitaires de France, Paris, 1957. 199 pp.

Les Facteurs de la Croissance Cellulaire. Activation et inhibition. J. André Thomas. Masson, Paris, 1956. 425 pp. F. 4000.

Diffusion. Methoden der Messung und Auswertung. W. Jost. Steinkopff, Darmstadt, Germany, 1957. 177 pp. DM. 25.

Prehistoric Men. Robert J. Braidwood. Anthropology, Number 37. Chicago Natural History Series. Chicago Natural History Museum, Chicago, ed. 3, 1957. 187 pp. Paper, $1.25.

Abbreviated Proceedings of the Oxford Mathematical Conference for Schoolteachers and Industrialists. Held at Trinity College, Oxford, 8–18 Apr. 1957. Oxford University Delegacy for Extra-Mural Studies. Times Publishing Co., Printing House Square, London, E.C.4, 1957. 111 pp. 2s. 6d.

Cosmetics, Science, and Technology. Edward Sagarin, Ed. Interscience, New York, 1957. 1452 pp. $25.

Economic Backwardness and Economic Growth. Studies in the theory of economic development. Harvey Leibenstein. Wiley, New York; Chapman & Hall, London, 1957. 309 pp. $6.75.

Behaviour of Metals at Elevated Temperatures. Lectures delivered at the Institution of Metallurgists refresher course, 1956. Published for the Institution of Metallurgists. Iliffe, London; Philosophical Library, New York, 1957. 129 pp. $6.

Radio Astronomy. International Astronomical Union Symposium No. 4. H. C. Van De Hulst, Ed. Cambridge University Press, New York, 1957. 420 pp. $9.50.

The Vertebrate Visual System. Its origin, structure, and function and its manifestations in disease with an analysis of its role in the life of animals and in the origin of man. Preceded by a historical review of investigations of the eye, and of the visual pathways and centers of the brain. Stephen Ployak. Heinrich Kluver, Ed. University of Chicago Press, Chicago, 1957. 1408 pp. $45.

Chemistry of Natural and Synthetic Rubbers. Harry L. Fisher. Reinhold, New York; Chapman & Hall, London, 1957. 215 pp. $6.50.

The Physical and Chemical Basis of Inheritance. George W. Beadle. Oregon University Press, Eugene, 1957. 47 pp. Paper, $1.

Rhythmic and Synthetic Processes in Growth. Fifteenth symposium of the Society for the Study of Development and Growth. Dorothea Rudnick, Ed. Princeton University Press, Princeton, N.J., 1957. 224 pp. $7.50.

The Administrative State. An introduction to bureaucracy. Fritz Morstein Marx. University of Chicago Press, Chicago, 1957. 212 pp. $4.

Copernicus. The founder of modern astronomy. Angus Armitage. Yoseloff, New York, 1957. 236 pp. $5.

The Biologic Basis of Cancer Management. Freddy Homburger. Hoeber-Harper, New York, 1957. 372 pp. $10.

Strength of Materials. F. R. Shanley. McGraw-Hill, New York, 1957. 802 pp. $8.50.

Antiseptics, Disinfectants, Fungicides, and Chemicals and Physical Sterilization. George F. Reddish, Ed. Lea & Febiger, Philadelphia, ed. 2, 1957. 975 pp. $15.

Introduction to Biostatistics. Huldah Bancroft. Hoeber-Harper, New York, 1957. 220 pp. $5.75.

The Handbook of Feedstuffs. Production, formulation, medication. Rudolph Seiden and W. H. Pfander. Springer, New York, 1957. 613 pp. $8.

Handbuch der Physik. Vol. XLII. *Nuclear Reactions III.* S. Flugge, Ed. Springer, Berlin, 1957. 633 pp. DM. 135.

Die Mikrophotographie. Kurt Michel. Springer, Vienna, 1957. 772 pp. $33.30.

The Student-Physician. Robert K. Merton, George G. Reader, Patricia L. Kendall, Harvard University Press (for the Commonwealth Fund), Cambridge, Mass., 1957. 372 pp. $5.

An Introduction to Probability Theory and Its Applications. vol. I. William Feller. Wiley, New York; Chapman & Hall, London, ed. 2, 1957. 476 pp. $10.75.

Laboratory Manual of Batch Distillation. F. J. Zuiderweg. Interscience, New York, 1957. 134 pp. $3.50.

The Fascination of Numbers. W. J. Reichmann. Essential Books, Fair Lawn, N.J., 1957. 176 pp. $4.

Meetings and Societies

Quaternary Research

The fifth congress of the International Association on Quaternary Research (INQUA) met in Madrid and Barcelona, Spain, 2–15 Sept. Nearly 300 scientists from more than 20 countries, and including geologists, biologists, archaeologists, geographers, and others interested in the most recent epoch of geologic time, were present.

Organized under the auspices of the Government of Spain, the congress met under the presidency of J. M. Albareda, secretary of the Consejo Superior de Investigaciones Cientificas.

During a week of sessions in Madrid and a day in Barcelona, members of the congress heard and discussed many papers dealing with the stratigraphy, chronology, glacial geology, paleoclimatology, geomorphology, ancient soils, shore lines, paleontology, and ancient cultures of the Pleistocene epoch. Several field excursions were held both before and during the Madrid sessions. A six-day excursion through eastern Spain and Mallorca, in which 240 members participated, separated the Madrid sessions from those in Barcelona.

At a final general meeting on 14 Sept. it was decided to accept an invitation from the Polish delegates to hold the sixth INQUA congress in Warsaw in the summer of 1961.

RICHARD FOSTER FLINT
Department of Geology, Yale University, New Haven, Connecticut

Rocket and Satellite Conference

An international conference on rocket and earth-satellite programs for the International Geophysical Year was held in Washington from 30 September to 5 October. This was the first international conference on the IGY to be held in the United States.

The conference was called by the Special Committee for the International Geophysical Year (CSAGI), which asked the National Academy of Sciences to act as host. The conference brought together delegates from the various national committees participating in research rocket and satellite programs. Chairman was L. V. Berkner, president of the International Council of Scientific Unions and CSAGI reporter on rockets and satellites. Hugh Odishaw, executive director of the U.S. National Committee for the International Geophysical Year, was chairman of the General Arrangements Committee.

Official delegates were as follows: Australia, K. E. Bullen; Canada, D. C. Rose, L. F. Smith; Chile, Enrique Ortiz; Cuba, Jesus Francisco de Albear, Luis Larragoiti; Ecuador, Neptali Bonifaz, Carlos Castro, Alfredo Schmitt; France, Lt. Gen. J. Guerin; India, A. P. Mitra; Iran, H. K. Afshar; Japan, Takeo Hatanaka; Peru, Jorge A. Broggi; United Kingdom, Alastair Anthony, W. T. Blackband, J. G. Davies, H. S. W. Massey; United States, W. Berning, G. M. Clemence, Michael Ference, N. C. Gerson, John P. Hagen, J. Hanessian, Joseph Kaplan, Homer E. Newell, Hugh Odishaw, W. J. O'Sullivan, W. H. Pickering, Richard W. Porter, J. G. Reid, Athelstan Spilhaus, W. G. Stroud, J. W. Townsend, Fred L. Whipple, P. H. Wyckoff (in addition, 49 scientists and engineers who are active in the USNC–IGY satellite and rocket programs served as delegates-at-large); U.S.S.R., A. A. Blagonravov, A. M. Kasatkin, Sergei M. Poloskov; CSAGI, Sydney Chapman (president), L. V. Berkner (vice president and reporter for rocket and satellite programs), V. V. Beloussov (member), M. Nicolet (secretary-general), A. Day (coordinator), A. H. Shapley (reporter for World Days and Communications).

The conference opened 30 September with a plenary session, when status reports by the various national delegations were presented. The conference then divided into four working groups: Rocketry; Satellite Vehicles, Launching, and Tracking; Satellite Internal Instrumentation; and CSAGI Manual on Rockets and Satellites. These groups met at various times from 1 through 4 October.

A number of special papers—on satellite vehicles, launching, and tracking; satellite ground-based scientific experiments; orbiting satellite devices and internal instrumentation; IGY rocketry program results; and IGY rocket-research vehicles, techniques, and instrumentation—were presented at special sessions.

The closing session of the conference was held 5 October. There was a brief description, by Blagonravov, of the Soviet satellite, which had been launched 4 October. Conference resolutions were then presented. Detlev W. Bronk, president of the National Academy of Sciences, addressed the delegates, stressing the broad base of international cooperation which underlies the IGY program.

The resolutions, which were adopted unanimously, call for the prompt reporting of rocket-firing data to World Data Centers on special rocket-flight information summary forms developed and agreed on during the conference, within 2 weeks after each firing. The conference further resolved that there be a mutual interchange of rocket instrumentation and equipment and an interchange of personnel among countries participating in the IGY rocket program. The final resolution concerning rockets calls for simultaneous launching of rockets on 18 June 1958, during a World Meteorological Interval.

Resolutions concerning the earth-satellite program emphasized the need for additional visual and optical stations for satellite tracking, especially in higher latitudes, and for additional radio receiving stations providing tracking and telemetry reception at 108, 20, and 40 megacycles per second.

The conference noted the possibility of using the facilities of existing ionospheric stations to receive satellite-telemetered signals as well as the possibility of gaining interesting ionospheric data by means of radio amateur and volunteer observations of the Soviet satellite.

To implement the recommendation that additional telemetry stations be set up by research institutions and amateur radio groups, the conference recommended that both the U.S. and the U.S.S.R. provide advance data about the forms of signals which satellites would transmit and that they also prepare articles about their systems, to be disseminated to amateur radio groups.

The conference recommended that the U.S. and the U.S.S.R. make arrangements for the rapid dissemination of information on satellite orbits and stated that it considered the exchange of publications, technical data, and scientific instruments pertaining to satellites highly desirable.

The need for coordination in content of transmitted positional and orbital data and for consistency of basic constants and standards used in computation was also noted; the conference recommended that interested national committees meet in the near future to discuss these matters.

The final group of resolutions concerned the need for additional coordination on those items that could not be settled at the conference and recom-

mended that special attention be given to the need for continued programs of scientific research utilizing instrumented rockets and earth satellites after the close of the IGY. To this end the conference recommended that countries undertaking such plans make information concerning their plans available as soon as possible.

High Polymers

The International High Polymer Conference will be held at the University of Nottingham, England, 21–24 July 1958. Proceedings will be divided between two sections meeting simultaneously:

Section A (reaction mechanisms and kinetics): heterogeneous polymerization, including trapped or inactive radicals; production of graft and block copolymers.

Section B (physical, thermodynamic, and mechanical properties).

The number of papers for each section is limited to 20, and those who wish to present a paper are invited to submit abstracts of 200 to 300 words in English, French, or German *before 15 December* to the International High Polymer Conference, The University, Manchester, 13, England.

Scientific Study of Religion

The spring meeting of the Society for the Scientific Study of Religion will be held 12 April 1958 at Columbia University. The society requests that scholars wishing to submit brief papers of an empirical nature send three copies of a 300-word abstract to the chairman of the Planning Committee, Lauris Whitman, 297 Fourth Ave., New York, N.Y.

Forthcoming Events

December

1–6. American Soc. of Mechanical Engineers, annual, New York, N.Y. (C. E. Davies, ASME, 29 W. 39 St., New York 18.)

1–15. Bahamas Medical Conf., 4th, Nassau, Bahamas. (B. L. Frank, 1290 Pine Ave., W. Montreal, Que., Canada.)

2–3. American College of Chest Physicians, interim, Philadelphia, Pa. (ACCP, 112 E. Chestnut St., Chicago 11, Ill.)

2–5. American Rocket Soc., annual, New York. (J. J. Harford, ARS, 500 Fifth Ave., New York 36.)

2–5. Entomological Soc. of America, annual, Memphis, Tenn. (R. H. Nelson, ESA, 1530 P St., NW, Washington 5.)

3–4. Human Factors in Systems Engineering, symp., Philadelphia, Pa. (C. Fowler, American Electronic Labs., 121 N. 7 St., Philadelphia.)

3–6. American Medical Assoc., clinical, Philadelphia, Pa. (AMA, 535 N. Dearborn St., Chicago 10, Ill.)

4–8. American Psychoanalytic Assoc., New York, N.Y. (J. N. McVeigh, APA, 36 W. 44 St., New York 36.)

4–10. American Acad. of Optometry, annual, Chicago, Ill. (C. C. Koch, 1506–1508 Foshay Tower, Minneapolis 2, Minn.)

5–7. Texas Acad. of Science, annual, Dallas. (G. C. Parker, Education Dept., Texas A&M College, College Station.)

5–8. American College of Cardiology, 6th interim, Cincinnati, O. (P. Reichert, ACC, Empire State Bldg., New York 1.)

6–7. Oklahoma Acad. of Science, annual, Enid. (J. T. Self, Dept. of Zoology, Univ. of Oklahoma, Norman.)

7–8. American Acad. of Dental Medicine, New York, N.Y. (S. Ross, 136 E. 36th St., New York 16.)

8–11. American Inst. of Chemical Engineers, annual, Chicago, Ill. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

9–11. Fluorides Symp., Cincinnati, Ohio. (Secretary, Inst. of Industrial Health, Kettering Laboratory, Eden and Bethesda Aves., Cincinnati 19.)

9–13. Eastern Joint Computer Conf., Washington, D.C. (H. H. Goode, Dept. of Electrical Engr., Univ. of Michigan, Ann Arbor.)

9–22. Southeast Asia Soil Science Conf., 1st, Manila, Philippines. (I. G. Valencia, Bureau of Soils, P.O. Box 1848, Manila.)

10–11. Water Quality Control for Subsurface Injection, 2nd annual conf., Norman, Okla. (M. L. Powers, Extension Div., Univ. of Oklahoma, Norman.)

13–14. Association for Research in Nervous and Mental Disease, 37th annual, New York, N.Y. (R. J. Masselink, 700 W. 168 St., New York 32.)

15–18. American Soc. of Agricultural Engineers, Chicago, Ill. (J. L. Butt, ASAE, St. Joseph, Mich.)

16–18. Air Traffic Control Symp., Philadelphia, Pa. (Air Traffic Symp., Franklin Inst. Labs., 20th St. and Parkway, Philadelphia 3.)

17–19. Nuclear Sizes and Density Distributions Conference, Stanford, Calif. (R. Hofstadter, Stanford Univ., Stanford, Calif.)

19–21. American Physical Soc., Stanford, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4.)

26–27. Northwest Scientific Assoc., annual, Spokane, Wash. (W. B. Merriam, Geography Dept., State College of Washington, Pullman.)

26–30. American Assoc. for the Advancement of Science, annual, Indianapolis, Ind. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5.)

The following 43 meetings are being held in conjunction with the AAAS annual meeting.

AAAS Acad. Conference, annual (Father P. H. Yancey, Spring Hill College, Mobile, Ala.). 28 Dec.

AAAS Cooperative Committee on the Teaching of Science and Mathematics (F. B. Dutton, Dept. of Chemistry, Michigan State Univ., East Lansing). 27 Dec.

Alpha Epsilon Delta (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.). 28 Dec.

American Astronomical Soc. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.). 27–30 Dec.

American Geophysical Union (E. M. Brooks, Dept. of Geophysics, St. Louis Univ., St. Louis 8, Mo.).

American Medical Assoc. Committee on Cosmetics (Mrs. V. L. Conley, AMA, 535 N. Dearborn St., Chicago, Ill.). 28–29 Dec.

American Meteorological Soc. (K. C. Spengler, AMS, 3 Joy St., Boston, Mass.)

American Nature Study Soc., annual (R. L. Weaver, School of Natural Resources, Univ. of Michigan, Ann Arbor). 26–30 Dec.

American Physiological Soc. (F. A. Hitchcock, Dept. of Physiology, Ohio State Univ., Columbus 10).

American Political Science Assoc. (C. S. Hyneman, Dept. of Government, Indiana Univ., Bloomington). 29 Dec.

American Psychiatric Assoc. (M. Greenblatt, Massachusetts Mental Health Center, 74 Fenwood Rd., Boston 15). 29–30 Dec.

American Soc. of Hospital Pharmacists (G. E. Archambault, Pharmacy Branch, U.S. Public Health Service, Washington 25).

American Soc. of Naturalists (B. Wallace, Biological Lab., Cold Spring Harbor, Long Island, N.Y.).

American Statistical Assoc. (V. L. Anderson, Statistical Lab., Purdue Univ., Lafayette, Ind.).

American Sociological Soc. (V. H. Whitney, Brown Univ., Providence, R.I.). 28 Dec.

Association of American Geographers (L. L. Ray, U.S. Geological Survey, Washington 25).

Association for Computing Machinery (J. E. Robertson, Digital Computer Lab., Univ. of Illinois, Urbana).

Astronomical League (W. Garnatz, 2506 South East St., Indianapolis.)

Beta Beta Beta (Mrs. F. G. Brooks, P.O. Box 336, Madison Sq. Station, New York 10). 27 Dec.

Biometric Soc., ENAR (T. A. Bancroft, Dept. of Statistics, Iowa State College, Ames).

Conference on Scientific Editorial Problems, annual (G. L. Seielstad, Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). 26–30 Dec.

Conference on Scientific Manpower, annual (T. J. Mills, National Science Foundation, Washington 25). 30 Dec.

Ecological Soc. of America (A. A. Lindsey, Dept. of Biological Sciences, Purdue Univ., Lafayette, Ind.). 27–29 Dec.

Metric Assoc. (J. T. Johnson, 694 West 11 St., Claremont, Calif.).

National Acad. of Economics and Political Science (D. P. Ray, Hall of Government, George Washington Univ., Washington, D.C.).

National Assoc. of Biology Teachers, annual (Miss I. Hollenbeck, Southern Oregon College of Education, Ashland). 26–31 Dec.

National Assoc. for Research in Science Teaching (G. G. Mallinson, Western

Michigan College, Kalamazoo). 26–30 Dec.

National Assoc. of Science Writers (J. Troan, *Pittsburgh Press,* Pittsburgh, Pa.).

National Council of Teachers of Mathematics (P. Peak, College of Education, Indiana Univ., Bloomington). 27 Dec.

National Geographic Soc. (W. R. Gray, NGS, 16th and M Sts., NW, Washington 6). 29 Dec.

National Science Teachers Assoc. (R. W. Schulz, Emmerich Manual Training High School, 2405 Madison Ave., Indianapolis 25). 26–30 Dec.

National Speleological Soc. (Brother G. Nicholas, LaSalle College, 20th and Olney Aves., Philadelphia 41, Pa.). 28 Dec.

Philosophy of Science Assoc. (C. W. Churchman, Case Inst. of Technology, Cleveland, Ohio).

Scientific Research Soc. of America, annual (D. B. Prentice, 56 Hillhouse Ave., New Haven 11, Conn.). 27 Dec.

Sigma Delta Epsilon, annual (Miss M. Chalmers, Dept. of Chemistry, Purdue Univ., Lafayette, Ind.). 26–30 Dec.

Sigma Pi Sigma (M. W. White, Pennsylvania State Univ., University Park). 27 Dec.

Society for the Advancement of Criminology (D. E. J. MacNamara, New York Inst. of Criminology, 40 E. 40 St., New York 16). 27–28 Dec.

Society for General Systems Research, annual (R. L. Meier, Mental Health Research Inst., Ann Arbor, Mich.).

Society for Industrial Microbiology, Washington Section (W. N. Ezekiel, Bureau of Mines, Washington 25).

Society for Investigative Dermatology (H. Beerman, Univ. of Pennsylvania School of Medicine, Philadelphia 3). 28–29 Dec.

Society of the Sigma Xi, annual (T. T. Holme, 56 Hillhouse Ave., New Haven 11, Conn.). 27 Dec.

Society of Systematic Zoology, annual (R. E. Blackwelder, Box 500, Victor, N.Y.). 26–31 Dec.

United Chapters of Phi Beta Kappa, annual address (C. Billman, 1811 Q St., NW, Washington, D.C.). 27 Dec.

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27. Association for Symbolic Logic., Cambridge, Hass. (J. Barlaz, Rutgers Univ., New Brunswick, N.J.)

27–28. Linguistic Soc. of America, Chicago, Ill. (A. A. Hill, Box 7790, University Station, Austin 12, Tex.)

27–30. American Finance Assoc., annual, Philadelphia, Pa. (G. E. Hassett, Jr., New York Univ., 90 Trinity Pl., New York 6.)

28–29. American Folklore Soc., annual, Chicago, Ill. (M. Leach, Box 5, Bennett Hall, Univ. of Pennsylvania, Philadelphia 4, Pa.)

28–30. American Anthropological Assoc., annual, Chicago, Ill. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

28–30. American Economic Assoc., annual, Philadelphia, Pa. (J. W. Bell, Northwestern Univ., Evanston, Ill.)

28–30. Archaeological Inst. of America, annual, Washington, D.C. (C. Boulter, 608, Univ. of Cincinnati Library, Cincinnati 21, Ohio.)

(See issue of 18 October for comprehensive list)

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science ***does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to*** Science, ***Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).***

■ ELECTROMETER-MEGOHMMETER measures resistance from 5 Mohm to 5×10^9 Mohm in nine decade ranges. The instrument consists of a cathode-follower electrometer with a series of input shunt resistors and a regulated 500-v power supply. Accuracy varies from 3 percent on the lower ranges to 10 percent on the highest. Open-circuit input-voltage drift rate is about 0.02 v/min. (Walter N. Trump, Dept. S684)

■ RELAY, of subminiature size, will provide continuous duty at 200°C and intermittent duty to 250°C. The coil assembly is hermetically isolated from the contact assembly to avoid contamination of contacts. Weight is 0.5 oz. (Reltron Corp., Dept. S687)

■ ULTRASONIC PROCESSING TANKS of 5-gal and 8-gal capacities operate at a frequency of 20 kcy/sec. The tanks operate with 400-w and 700-w generators, respectively. Treatment chambers, made of No. 302 stainless steel, are equipped with input and outlet drains. (General Ultrasonics Co., Dept. S691)

■ VACUUM INDUCTION FURNACE has a capacity of 12 lb of molten steel. Temperatures of 1700°C or higher, depending on crucible material, are produced. Pressure is maintained at 1 μ. Accessories include a special crucible for heat-treating, inert-gas introduction kit, and feed-through for power and water. (National Research Corp., Dept. S698)

■ POWER SUPPLY, regulated by a transistor-magnetic amplifier, furnishes 0 to 60 v at 5 amp. Maximum ripple is 1 mv r.m.s. Line regulation is 5 mv static and less than 5 mv dynamic. Load regulation is less than 25 mv. (Perkin Engineering Corp., Dept. S699)

■ VERTICAL AMPLIFIER for a 10 Mcy/sec oscilloscope has input sensitivity of 5 mv/cm from d-c to 10 Mcy/sec. Drift after ½-hr warm-up is less than 1 cm/hr. Sensitivity is adjustable from 0.005 to 50 v/cm. (Hewlett-Packard Co., Dept. S701)

■ DIRECT-WRITING OSCILLOGRAPH RECORDER provides up to 19 channels of curvilinear recording on a 24.5-in. chart. Either ink or electric writing is available. Pen spac-

ing is 2 in. for assemblies with 12 channels or less, and 1.25 in. for assemblies with 13 through 19 channels. Eight chart speeds from 1 to 250 mm/sec are selectable. Chart paper is available printed or unprinted and in roll or folded form. (Offner Electronics Inc., Dept. S705)

■ VACUUM TUBE VOLTMETER for a-c will withstand temperatures of 85°C. Accuracy of ± 2 percent, full scale, is retained at 71°C. The input impedance is 1 Mohm, and the frequency range is 20 to 50,000 cy/sec. Ranges from 30 mv to 300 v are available. (Trio Laboratories, Inc., Dept. S702)

■ FLOW COLORIMETER uses ratio recording to provide continuous analysis of color. Measurements can be made from 350 to 1000 mμ in the presence of turbidity or entrained gas. Path lengths from 1 to 100 cm are available. Insensitivity both to source variations and to accumulation of foreign matter on the cell windows is said to be a feature of the instrument's performance. (Beckman Instruments, Inc., Dept. S703)

■ ELECTROCARDIOGRAPH ELECTRODE, for use during surgery, permits the use of a sterile hypodermic needle as a subcutaneous contact. The subcutaneous electrode is said to make optimum contact and to eliminate skin resistance and the problem of paste drying. (Pacific Technical Agency, Dept. S704)

■ FORCE CALIBRATOR is a direct-reading, automatic balance, digital servo indicator. The indicator is calibrated with a strain-gage load cell for tension or compression measurements. Accuracy is 0.1 percent of reading or of lowest range, whichever is greater. National Bureau of Standards calibration can be supplied. (Gilmore Industries, Inc., Dept. S706)

■ SEQUENTIAL SAMPLER for air-pollution studies takes 12 consecutive samples by means of impingers, gas bubblers, or dry filters. Sampling is controlled by a series of midget solenoid valves connected to a common vacuum manifold. The sampling program may be adjusted by interchanging timing gears. (Gelman Instrument Co., Dept. S708)

■ THERMOMETER, of stainless steel, is of straight form. An adjustable mounting nut makes it possible to turn and lock the thermometer head for maximum visibility. Stem lengths are 2½ to 72 in. A variety of ranges is available; accuracy is 1 percent of range. (W. C. Dillon and Co., Inc., Dept. S709)

■ CURVE READER uses a flying-spot scanner to convert a photographic transparency of a drawn curve into a voltage signal. A multiplier-phototube circuit detects the

flying spot when it is below the curve and controls a Schmidt trigger to produce constant-amplitude, variable-width pulse output. Accessory items include an automatic camera for preparation of transparencies and time-base generators to sweep the flying spot. (Spar Engineering and Development, Inc., Dept. S711)

■ FILTER FLASKS of high-temperature polyethylene have extra-heavy walls to withstand vacuum. Volume is 500 ml. (Palo Laboratory Supplies, Inc., Dept. S710)

■ CELL-DESTRUCTION DEVICE permits cell walls of chloroplast material, blood cells, unicellular organisms, homogenates of animal tissue, and other biological particles to be disintegrated without disturbing the nuclei. The device is a pressure cell in which the specimen is subjected to a pressure of 20,000 lb/in.^{2}, which is suddenly released. The cell is equipped with a pressure relief valve, a sample outlet, and a volume-adjusting device. (American Instrument Co., Dept. S712)

■ AMPLIFIER with 20-w output uses transistor circuitry to achieve small size. The unit, occupying a volume of 50 in.^{3}, has a signal-to-noise ratio greater than 30 db with less than 3 percent harmonic distortion at the low-frequency end. Frequency range from 50 to 20,000 cy/sec is available. (Universal Transistor Products Corp., Dept. S713)

■ HYGROMETER measures relative humidity from 32 to 180°F. The humidity-sensing element of the instrument is a plastic base coated with an absorbing surface whereby changes in vapor pressure and relative humidity are converted into electrical signals. Relative humidity is indicated directly over the 30-to-100 percent range. (American Laboratory Apparatus Corp., Dept. S714)

■ NEUTRON SURVEY METER, completely transistorized, is insensitive to gamma rays below 100 r/hr. Fast neutrons with energies between 0.1 and 15 Mev are detected by proton-recoil detector; slow neutrons, with energies below 0.1 Mev, are detected by an enriched BF_3-filled proportional counter. Readout is logarithmic. (Radiation Counter Laboratories, Inc., Dept. S731)

■ DECADE RESISTORS are designed to be plugged in for analog computer applications, and thus they permit constant coefficients to be set and stored for future use. Two types are available, with 10.6 and 10.7 ohm maximum resistance, respectively. (Goodyear Aircraft Corporation, Dept. S716)

JOSHUA STERN
National Bureau of Standards

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Bacteriologist; Ph.D.; 5 years, senior scientist, pharmaceutical company; 4 years, associate professor, microbiology, medical school. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

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APPLICATION FOR HOTEL RESERVATIONS

124th AAAS MEETING

Indianapolis, December 26-30, 1957

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Indianapolis. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Indianapolis and thereby avoid delay and confusion. (Exception: Members of the American Astronomical Society who wish reservations at the Marott Hotel, 2625 North Meridian Street, are asked to correspond directly with that hotel.) The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less.

As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; for a lower rate, share a twin-bedded room with a colleague. Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 to 3.00 per night. Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

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Claypool	7.00–10.00	9.50–14.00	10.50–14.00	13.50–34.00
Continental	8.00–10.00	8.00–12.00	8.00–12.00	12.00–15.00
Marott	7.00–14.50	9.00–14.50	10.00–17.50	14.50 and up
Severin	6.00– 9.00	8.50–12.50	11.00–15.00	25.00
Sheraton-Lincoln	6.50–11.50	9.85–15.00	13.35–16.00	24.35 and up
Warren	6.50–10.50	8.50–12.50	12.00–13.00	25.00–35.00
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